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Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXVI NO. 1

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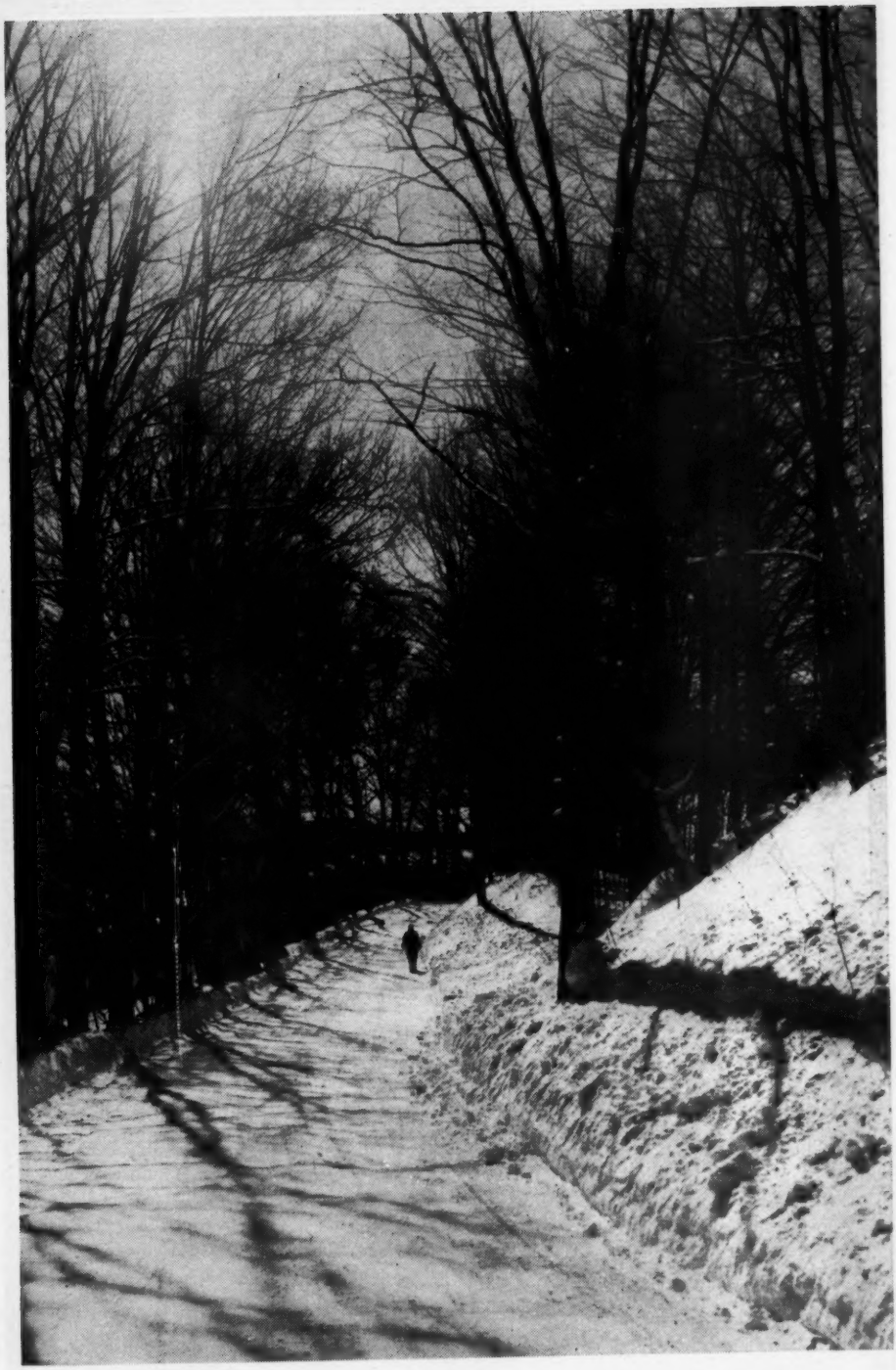

A Shady Lane!

Better Crops with PLANT FOOD

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Vol. XXXVI WASHINGTON, D. C., JANUARY 1952 No. 1

It is just like . . .

Breaking Old Sod

Jeff McDermid

INASMUCH as the combined propagandist efforts of agricultural leaders early in 1952 will be directed toward the possibility and desirability of attaining new superlatives in food and fiber production, we take a long backward look to see what the pronouncements from on high were 35 years ago. That era in which so many of us made our first apprenticeships to the food and feed craft seems a long time ago. The first world war was at its height, Woodrow Wilson was president, and David Houston was the secretary of agriculture, with Carl Vrooman as assistant. It brought out the first critical test of teamwork between the loyal and able members of the land-grant colleges, the farm societies, the commercial suppliers of agriculture, and the chiefs of bureau work in the U. S. Department of Agriculture.

While agriculture had been formulating its policies and adding to its strength and sinews for a decade or two before the imperial German dynasty did its dirty work and dragged us in, we were not able to produce as much per acre, per livestock unit, and per farm worker as the second world war found our farms prepared to produce. But the task was even harder when Hitler went rampaging—and thanks to more lime and fertilizer, hybrid corn, tractors and power equipment, DDT and similar pesticides, agriculture's accoutrements for war were far ahead of the best we had to offer in the period to which we now return in retrospect.

Before going right into the details of directed effort in behalf of more

food and its conservation which Houston & Co. took in 1917, let's get some of the background smoothed out so we know what had been uppermost in agricultural doings outside of the war itself.

THE Department in January 1917 told the nation the crop production situation in statistical form. Based on 101,880,000 population then noted for the country, we were producing 220 pounds of beef, pork, and mutton per capita, 608 pints of milk, 21 pounds of butter, 17 dozen eggs, 40 pounds of cereals, 20 pounds of sugar, 3 bushels of orchard fruits, and a quarter of a box of citrus per year, all on per capita basis. You can reach for that Yearbook and check your own relative comparisons with the rate we produce today for 151 million, but I can say at a glance that we seem to lag behind now on only our total meats and total butter produced per capita. Today we have more variety, and we have emphasized the oil crops and livestock products, instead of trying to do our part mostly on wheat tonnages as we did in 1917.

The facilities just created by the Federal farm loan act were being set up back then. The interest charges were to be six per cent or less, but never more than one per cent over the rate paid on bonds sold by the Federal land banks. The Treasury Department had full charge of the new system, but the Agriculture Department promised to supply information and give help to farmers who wanted to set up local farm loan associations.

Agencies were introducing the soybean to our farmers. They were told of the origin in Japan, and how much daily use was made of soybeans overseas for sauces, soy cheese, vegetable milk, flour, and animal meals. Farmers were told that a factory in Ohio was making a milk product from soys to be used by bakers and chocolate makers (properly labeled) and how use of soybean oil meal for livestock was confined largely for the time being to the Pacific States, where soybean mill feed is used "by both dairymen and poultrymen" in balancing rations deficient in protein. To add extra appeal, one note stated that soybeans could be ground and used successfully as a coffee substitute, and might also make up part of the ingredients for candy manufacture.

ELEVEN public hearings were held in February 1917 by the Department to afford interested persons a chance to present their views on proposed official standards for wheat. The Bureau of Plant Industry and the Office of Markets and Rural Organization had the job of promulgating the grades after devising them. Wm. A. Taylor and Charles J. Brand were chiefs of the respective bureaus—and the latter one had delved into the new and developing theory that farmers should know and do something more intelligent about marketing products after they produced them. This sudden craze for market studies and ways to find out what occurred in the "dark or twilight" zone of handling cash farm products, and the hunch that farmers must come closer to the ultimate consumers, all fringed the big picture of farm life in the midst of World War I.

The Office of Public Roads and Rural Engineering, Logan W. Page, director, had said that only about 277,000 miles, or 11 per cent of all the nation's highways outside of incorporated places, were improved with some form of surfacing. State highway departments the year before had surfaced about 10,000 miles of roads and maintained about 52,000 miles of main and trunk highways. The expenditures for all road and bridge work in the country were estimated at $219 million for 1916. This was an increase of 250 per cent from the level of 1900, they told anxious motorists who wanted to pave more mileage for the growing use of the chugging autos of the day—then deemed foes of farm peace and highway security. Even then their op-

ponents and the enemies of good roads did not know that a million citizens would die from use and abuse of the flivver and the limousine within 35 hectic years. (How many lives have been saved by motor vehicles remains a story to be researched from hospital and physician sources—including hundreds of infants born in hustling automobiles.) But we must not pause for philosophy.

There was a rumor circulated that spring to the effect that it was the intention of Secretary Houston and the good roads materials folks to force states to use certain specified types of materials before any state would get Federal aid out of the jackpot of $85 million which Congress had supplied. In denying this charge, Mr. Houston said that there were no restrictions whatever, direct or implied, and that the states might submit for approval any kind of road—even an earth road—and approval would be given if the construction was substantial and equal to traffic needs.

County agent work began in the North-central States in 1911, and a report made in 1917 showed the number of agents to be 420. The average yearly budget for this extension activity was given at $3,000, contributed by the Federal government, by the states through the colleges and the county supervisors, by individual farmers and public-spirited individuals and organizations. At the same time there were 478 counties with women "county agents" with a total combined budget of about $755,000.

CATTLE fever tick eradication was the theme of the hour, with bovine tuberculosis on the threshold of attack from state-federal cooperation. A. D. Melvin was chief of the Bureau of Animal Industry then. A published record in 1917 indicated that there were 485 infected counties left with tick control incompleted, while 437 counties had been fully released. In 1906 the total area with tick infection was 728,000 square miles, whereas by 1917 this had been cut by 309,000 miles to about 420,000 miles which was around 43 per cent of the cleanup program in finished form.

To drive a wedge of tick-free territory from the upper Mississippi Valley to the Gulf of Mexico right through the heart of the heaviest infection was the program set for 1917. By the end of the year the idea was to have the whole State of Mississippi released from quarantine, and a broad high road opened for the unrestricted shipment of cattle to outside markets. A conservative estimate by the authorities based on farm opinions was that $7.50 apiece had been added to the book values of all cattle in the areas where infection from ticks had been largely eliminated so that a free and open market could be counted upon. Where boll-weevil injuries to cotton crops caused sharp declines in land values during the previous decade, the report was that the conquest of the tick had not only restored but had advanced those average land values appreciably.

Commercial fertilizer of mineral origin was in the spotlight. The Bureau of Soils, Milton Whitney, chief, had secured a special fund from Congress to erect a plant on the southern Pacific Coast to experiment on a commercial scale with the recovery of potash from kelp. They were also testing losses of

(*Turn to page* 48)

Research Points the Way to Higher Levels of Peanut Production

By E. T. York, Jr.

North Carolina Agricultural Experiment Station, Raleigh, North Carolina

FEW crops can compete with peanuts for the reputation for peculiarity and uniqueness. The peculiarity begins with the name itself. The peanut or "ground nut," as it is sometimes called, is, in a true sense, not a nut but rather a pea. Its reputation for uniqueness is heightened by the fact that it is the only domestic plant whose flowers are produced above ground while its fruit develop beneath the surface of the soil.

The unpredictable behavior of peanuts to fertilization is legendary among agronomists who have experimented with this crop. Perhaps the most significant factor contributing to its reputation for peculiarity is the fact that the peanut has successfully "resisted" attempts at increased production, and the average yields in the United States are essentially no higher today than several decades ago. This, of course, is in marked contrast to the progress that has been made in increasing yields of other common field crops. In recent years, however, intensive research programs have helped to unravel many of the mysteries associated with the production of this crop. This work has indicated many reasons why peanuts behave as they do and it should serve as the basis for marked increases in production in the future.

The following discussion is for the most part based on work conducted at the North Carolina Agricultural Experiment Station with large-seeded bunch and runner type peanuts. The general relationships which have evolved from this work should also be applicable in other areas where the small seeded bunch and runner peanuts are grown.

Soils

A large proportion of the peanuts produced in this country are grown on Coastal Plain soils of the South Atlantic and Gulf States from Virginia to Alabama. In recent years the acreage in Texas and Oklahoma has also been expanded. Throughout these major producing areas, peanuts are grown on predominantly sandy soil.

An ideal soil for peanuts has been characterized as a well-drained, light-colored, loose, friable sandy loam.[1] Soils with desirable physical properties usually have a relatively low exchange capacity and are generally low in organic matter and reserves of plant nutrients. The fact that peanuts are grown on soils of low native fertility serves to emphasize the need for an extremely careful program of fertilization and management in order to maintain a high level of production.

Spacing

One of the principal factors limiting

[1] *The Peanut, The Unpredictable Legume.* The National Fertilizer Association. 1951.

peanut yields in many areas is the low plant population. In fact, the failure of peanuts to respond to many fertilization and management practices may result from plant populations which are only 40-60% adequate.

Despite the fact that the major portion of the fruit is produced in a circle with a radius of only 4 to 6 inches from the tap root, the large seeded bunch and runner peanuts are normally grown in 34 to 42-inch rows. In peanut spacing studies, yield increase of 600 to 1,200 pounds per acre have been realized by reducing the row width of the Virginia Bunch type peanuts from 36 inches to 24 and 18 inches. Higher yields have also been obtained with the Jumbo Runner variety grown in 36-inch rows instead of the conventional 40 to 42-inch rows.

Experiments with the large-seeded type have shown little effect of varying the spacing of plants within the row from 4 to 12 inches. However, to help compensate for poor germination and provide an adequate stand after the loss of plants from insect damage, diseases, and careless cultivation, it is recommended that seed be planted at least 6 to 8 inches in the drill. Even closer spacing has been found to be desirable with the small-seeded, Spanish variety.

One of the principal difficulties confronting most growers is that of adapting tractor equipment to plant, cultivate, and harvest peanuts in narrow rows. Various improvisions are being made to overcome this problem, however. One system which has proved satisfactory with the tricycle-type tractor consists of using a rear wheel spacing of 80 inches and alternate row width of 23 and 17 inches, permitting four rows of peanuts to be planted and cultivated in one operation instead of the usual two. For four-wheeled tractors with the cultivator frame mounted to the rear, the use of a 72-inch wheel spacing permits the handling of two 36-inch rows of corn, cotton, and soybeans, and either three 24-inch or four 18-inch rows of peanuts without adjusting the wheels. A number of farmers in North Carolina are using this system to grow peanuts in 24-inch rows with excellent results.

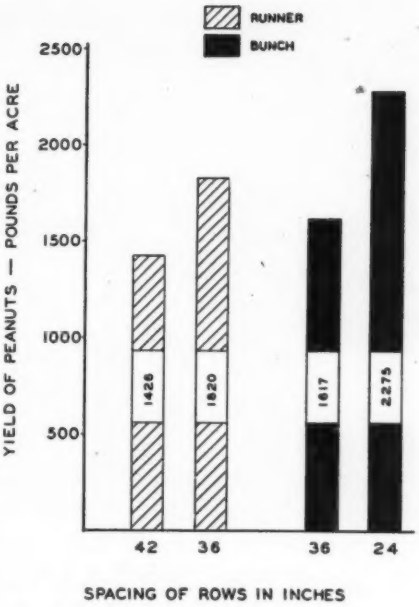

Fig. 1. Closer row spacing provides marked increases in peanut yields. Farmers have reported increased yields of over 1,000 pounds per acre from using row spacing of 18 inches as compared to the conventional 36 inches.

Fertilization

The fertilization problem in peanuts is related primarily to the maintenance of adequate supplies of potassium and calcium. Other nutrients added in fertilizer materials are seldom found to be beneficial.

Potassium. Peanuts have long had a notorious reputation for lowering the productivity of soils, and recent studies at the North Carolina Experiment Station have indicated that the deleterious effect of peanuts on soil productivity is due primarily to the removal of large amounts of potassium from the soil. However, despite this reduction in potassium level, peanuts normally respond little to direct applications of potassium fertilizers except on soils extremely deficient in this element.

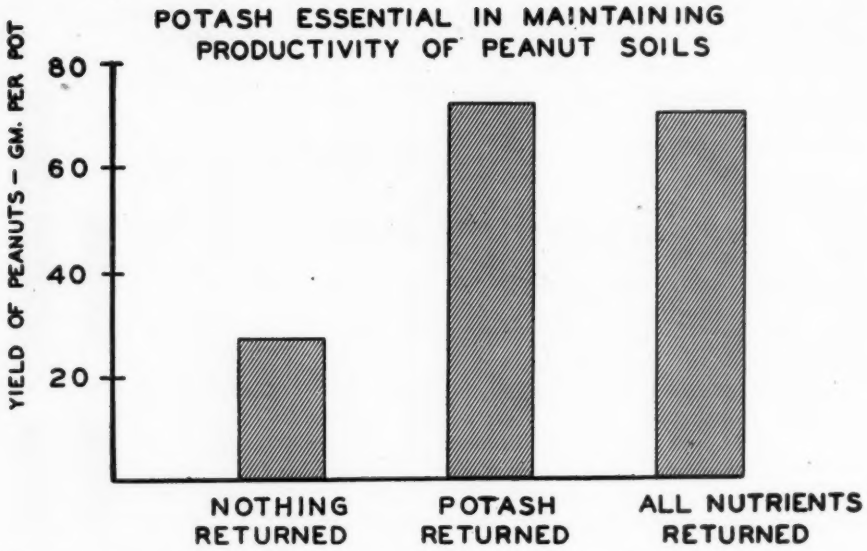

Fig. 2. A greenhouse experiment in which several successive crops of peanuts were grown on the same soil has demonstrated that high levels of production could be maintained by returning all of the potash taken out of the soil by each peanut crop.

Experiments have shown that from the standpoint of maintaining the productivity of peanut soils, it is desirable to grow peanuts in rotation with other well-fertilized crops. This work has indicated that it is better to maintain an adequate level of soil potassium by applying somewhat larger than normal rates of potassium to the other crops in the rotation rather than by fertilizing the peanuts directly. For example, in a two-year rotation of cotton and peanuts these studies have shown it to be better to apply 80 pounds of potash to the cotton and none to the peanuts than to apply 40 pounds to each crop.

The generally deficient level of potassium and the need for higher potash fertilization of peanut rotations are indicated by a recent summary of all soil analyses performed by the North Carolina Soil-testing Division during the July-June period, 1949-1950. This survey showed that almost two-thirds of all the soil samples from the nine principal peanut-producing counties were "low" or "very low" in potash.

On soils low in potassium, peanuts may respond to direct applications of potash fertilizers. On such soils it has been found desirable to apply 75 to 100 pounds of muriate of potash directly to the peanut crop either as a topdressing as the plants emerge or in bands to the side of the seed at planting.

Calcium. Growers in Virginia and North Carolina have followed the practice of applying gypsum or "landplaster" to peanuts for a number of years. Experiments have shown that the beneficial effect of this material is due to the calcium which it supplies. Furthermore, it has been demonstrated that the calcium tends to promote kernel development and reduce the number of "pops" or unfilled pods.

These studies have shown that calcium as well as other nutrients may be absorbed by the developing fruit as well as by the roots. This work has emphasized that calcium is relatively immobile in the plant and is not translocated in sufficient quantities from the root to meet the needs of the developing fruit. Thus to be most effective the calcium must be localized in the soil around the developing pods.

Numerous experiments have been

Fig. 3. Aside from supplying calcium to peanuts, lime is needed to maintain a favorable soil reaction. The stunted, light-colored plants in the background were growing on very acid soil (pH 4.8) while the more vigorous plants in the foreground had been limed to pH 5.8.

conducted to determine the most efficient means of supplying the calcium needs of peanuts. Generally, gypsum and liming materials have proved to be equally effective when used properly.

Best results have been obtained with gypsum when it is applied as a top-dressing as the plants begin to bloom. The material falls around the base of the plant in the area in which the fruit are formed. An application of 400 to 600 pounds per acre is considered to be sufficient.

Liming materials have proved to be most effective when applied broadcast at least two or three months before planting. Ideally the soil should be limed to approximately pH 6.1-6.2. Where this is done, sufficient calcium may, in most cases, be supplied to meet the needs of the developing fruit. However, on extremely sandy soils with a low cation exchange capacity, it may not be possible to supply sufficient calcium by liming to this desired pH level. In such cases it may be necessary to supplement the calcium in the liming materials with gypsum. On such light soils calcitic materials have been found to be superior to dolomitic forms of lime; however, because of the generally low level of magnesium in many of the soils on which peanuts are grown, it is considered to be desirable to use a dolomitic material and, if necessary, to supply additional calcium through the use of gypsum.

On extremely acid soils (pH 5.0 and below) lime has been found to be superior to gypsum. On such acid soils nitrogen deficiencies may result from inadequate inoculation.

When soils are limed in excess of pH 6.2-6.3, peanuts commonly exhibit manganese deficiency symptoms and yields may be greatly reduced. Because of the likelihood of overliming injury when an excess of lime is used, growers are cautioned to have soils tested to determine the exact amount needed. Once the desired soil pH has been attained, applications of 1,000 to 1,500 pounds of lime every three to four years is usually sufficient to maintain the proper pH and a satisfactory calcium level.

Nitrogen. The peanut is a legume

and when properly inoculated may respond little, if any, to nitrogen fertilizers. Normally when peanuts are grown on the same soil every two to four years the seed need not be inoculated before planting. However, inadequate inoculation may result in soil on which peanuts have not been grown for five years or longer. Nitrogen deficiencies may also occur when peanuts are grown on very acid soils.

Many growers apply small quantities of nitrogen in mixed fertilizers at planting, and a vegetative response to this nitrogen may often be observed in early season. However, by mid-season it is usually difficult to detect any visual differences or a difference in the nitrogen content of fertilized and unfertilized plants.

Phosphorus. The peanut has a relatively low phosphorus requirement. In fact, young seedlings may sometimes develop severe phosphorus toxicity symptoms when as much as 75 to 100 pounds of P_2O_5 per acre is applied at planting. Little response to phosphatic fertilizers has been observed with peanuts except on soils which were extremely deficient in this element. Experiments have demonstrated that when other crops grown in rotation with peanuts are fertilized adequately, phosphorus fertilizers need not be applied directly to peanuts.

Rotations

Although there is no single, superior peanut rotation, there are several factors which should be considered in the planning of rotations including peanuts. Because of the fact that peanuts remove from the soil large amounts of certain nutrients, particularly potash, peanuts should be grown in rotations with crops receiving relatively heavy fertilization.

To help facilitate the maintenance of adequate nutrient levels as well as to afford better insect and disease control, it would be desirable to grow peanuts in three to five-year rotations rather than in the two-year rotations which are commonly employed in many areas.

In recent experiments conducted over a 10-year period at the North Carolina Agricultural Experiment Station peanut yields have been increased approximately 40% through the use of leguminous cover crops in a cotton-peanut

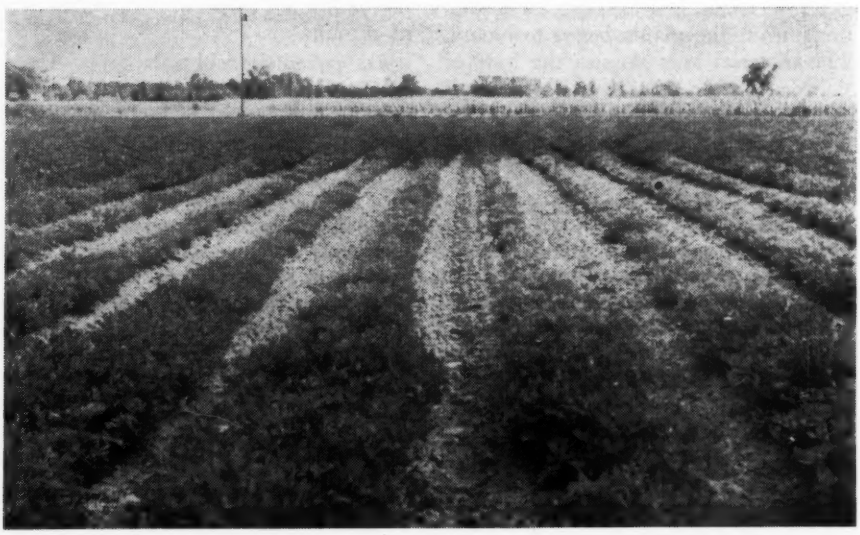

Fig. 4. Care should be taken to avoid overliming peanut soils. The stunted, chlorotic plants in the center of the picture were suffering from manganese deficiency caused by the use of too much lime.

rotation. Penetrometer measurements indicated that where the cover crops were turned under before planting the soil had less of a tendency to pack and crust and was in a much better physical condition. This factor is especially important in the production of peanuts because of the necessity for the pegs to penetrate the surface before fruits are formed. There is no evidence that the nitrogen supplied by the legumes was of any direct value to the peanuts.

Weed Control

Clean cultivation is perhaps of more importance with peanuts than with most other common crops because of the extreme difficulty of harvesting under weedy conditions. Experiments have indicated that the most satisfactory method of cultivating peanuts in early season consists of frequent operations with a rotary hoe. For best results it is important to cultivate at a time when the weeds are just emerging because a rotary hoe will not successfully remove large weeds. Many growers have virtually eliminated hand hoeing in peanuts through the use of the rotary hoe for six to eight weeks after planting.

Preliminary experiments have suggested that certain chemicals may prove satisfactory for the control of weeds in young stand of peanuts. Effective weed control for five to seven weeks after planting was obtained through the use of pre-emergence applications of the following materials: 8 and 16 pounds of pentachlorophenol or sodium pentachlorophenate; 6 and 9 pounds of an alkanolamine salt of dinitro ortho secondary butyl phenol; or 1½ pounds of acid equivalent of an alkanolamine salt of 2,4-D. None of these materials used at the indicated rates caused a reduction in stand or yields of peanuts. Neither was there any detectable off-flavor in the peanut butter or roasted peanuts prepared from the treated peanuts. The 2,4-D tended to delay emergence for three to four days. Although promising, these materials are not recommended for general use until further studies have been completed.

Fig. 5. In preliminary experiments, certain chemicals have afforded excellent control of grass and weeds for several weeks after planting. A pre-emergence spray was used on the area on the left, while the strip on the right was untreated. Neither area was cultivated.

Diseases[2]

Research on peanut diseases has been focused on three principal objectives: (1) To find suitable protectants to prevent seed decay, (2) to develop effective control for leaf-spot diseases, and (3) to study factors affecting various stem, root, peg, and fruit rots in an effort to develop satisfactory control measures.

The North Carolina Agricultural Experiment Station recommends the use of any one of four fungicides for treating peanut seeds: Arasan (tetramethyl thiuramdisulfide 50%) at the rate of three ounces per 100 pounds of seed, or either Spergon (tetrachloro para benzoquinone 98%), Ceresan (ethyl mercury chloride 2%), or Yellow Cuprocide (yellow copper oxide) at the rate of 4 ounces per 100 pounds of shelled seed. Peanut seed may be treated at any time within 90 days befor planting. The chemical dust

[2] Information on diseases supplied by W. E. Cooper, Research Assistant Professor of Plant Pathology, N. C. State College.

should be applied to the seed in an enclosed chamber where the seed are slowly agitated until thoroughly covered.

Peanut leaf-spot diseases are caused by two fungi: *Cercospora arachidicola* and *Cercospora personata*. These diseases reduce the yield of peanuts by causing the leaves to fall off the vines before the fruit mature. The control measures for both of these organisms are essentially the same. Most effective control and greatest response in yield have been obtained with the use of dusting sulfur with 4% metallic copper. Dusting sulfur alone has also been used effectively. For best results three applications should be made using 15 to 20 pounds of the dusting material per acre each time. In North Carolina it is recommended that the first application be made during the first 10 days of July and the others at 14-day intervals thereafter.

Southern stem rot, *Sclerotium rolfsii*, is generally present in peanut soils to some extent and at times causes severe losses. When peanuts are grown in rotation with soybeans or other crops which are attacked by this disease, the damage to peanuts is usually increased. It has also been observed that disease incidence is greater where many of the vines are covered with soil at the last cultivation. Peanut varieties exhibit differences in resistance to this disease, and in many peanut-breeding programs attempts are being made to incorporate disease resistance into new varieties.

During the past two years, rather widespread infestations of nematodes have been observed in the Virginia-Carolina peanut belt. The deleterious effects of these infestations are usually more pronounced on relatively light sandy soils and are characterized by markedly stunted plants with restricted root systems. Two types of organisms have been found to be responsible for this damage: (1) a root-knot nematode and (2) a "sting" nematode. Control measures which are now being studied will likely include the use of longer intervals between the growth of peanuts and other susceptible crops on infested soils. Soil fumigation has also proved effective in early trials.

Insects[3]

It is estimated that insects cause more than a million dollars damage to pea-

(*Turn to page* 47)

Fig. 6. A combination of improved practices pays off. This field yielded more than 3,500 pounds of peanuts per acre.

Simple Tests for Magnesium and Calcium in Plant Material and Magnesium in Soils

By Kuang Lu Cheng and Roger H. Bray

Department of Agronomy, Illinois Agricultural Experiment Station, Urbana, Illinois

SIMPLE and rapid tests for the determination of the nutrient elements in soils and plants have found an important place in applied agriculture for the diagnosis of nutrient deficiencies. Satisfactory soil tests for calcium, phosphorus, potassium, and the ammonia and nitrate forms of nitrogen are available (1) (4). Satisfactory tests on plant tissue can be made for the inorganic forms of potassium, phosphorus, and nitrate nitrogen (2). The tests for magnesium in soil extracts such as the titan yellow, thiazole yellow, and p-nitrobenzeneazoresorcinol tests have been only moderately satisfactory (1) (7), and no direct tests for magnesium and calcium on plant tissue are available. This paper describes direct spot test techniques for magnesium in soils and for magnesium and calcium in plant materials which may prove helpful in diagnosing calcium and magnesium deficiencies. So far they are only tests, not calibrated tests, although the magnesium test is partially calibrated. Their use for determining calcium and magnesium in soil and plant extracts is described by Cheng and Bray (3).

The Calcium Reagent

The calcium reagent is a solution of freshly prepared murexide which gradually loses its sensitivity on exposure to light and air. Except for Cu, Zn, Cd, and some other heavy metals not present in soil extracts or plants in amounts high enough to cause interference, murexide is specific for calcium.

The Magnesium Reagent

The magnesium reagent used for the soil and plant tissue test is Erichrome Black T, commonly known as F241.* Its chemical name is 1-(1-Hydroxy-2-naphthyazo)-5-nitro-2-naphthol-4-sulfonic acid. It forms a wine-red colored complex (Mg-F241) with magnesium in an alkaline solution.

It also complexes with Ca, Mn, Fe, Cu, and Zn. However, none of these are present in plant tissue or soil extracts in amounts high enough to cause interference. For example 1,000 ppm. of Ca causes no color change. However, acid and/or manganese changes F241 a pinkish red. The former is avoided by using a buffer solution. The manganese, on drying, changes from red to a grayed green color leaving a ring of wine-red color surrounding the grayed green spot if magnesium is also present.

Tissue Test for Calcium

Preparation of the test papers: Cut O. K. or Whatman # 42 filter paper into strips 1 by 3 inches. A small drop of saturated freshly prepared murexide

* F241 and the other organic chemicals can be purchased from the Eastman Kodak Company, Rochester, New York.

solution is placed on the filter paper to form a spot of about ½ inch in diameter. Three spots may be placed on each paper. It is ready for use as soon as it dries. Prepare these papers daily as needed. Stored in the dark in CO_2 they keep for a period of months, but lose their sensitivity rapidly in air.

Making the test: Press the plant sap out of a succulent part of the plant onto the spot with the aid of a pair of pliers.

Interpretation: If no calcium is present the murexide spot remains purplish red, but changes from purplish red to orange to yellow as the concentration of calcium increases. The reaction should be carried out under neutral to alkaline conditions. Acid destroys the color but a slight acidity of the plant sap will not interfere. Standard solutions of 0, 100, 300, 500, and 1,000 ppm. of calcium gave shades from purplish red to yellow.

How closely this range corresponds to the concentrations found in deficient plant materials is not known. When corn, soybean, and tomato plants known to be "high" in calcium were tested, yellow test colors were obtained. A soybean plant grown in a solution containing no calcium, when tested, did not change the color. However, no calibration for the test is suggested; each investigator must work out calibrations for his own plants. Research with the test is needed before any general practical use of the test can be suggested.

Soil and Tissue Tests for Magnesium

The preparation of the reagents:

1. F241 solution: Dissolve 0.15 gm. of F241 and 0.5 gm. of sodium borate in 10 ml. of methanol. Stir with a glass rod and make up to 25 ml. with methanol.
2. Complexing solution: Solution 2a. —Dissolve 10 gm. of potassium oxalate, 0.1 gm. of sodium borate, and 50 mgm. of sodium bicarbonate in 30 ml. of water and dilute to 50 ml. with water. Solution 2b.—Take 10 ml. of solution 2a and add 20 ml. of water.
3. Saturated borate solution: A saturated solution of sodium borate.

a. For plant tissues.

Preparation of the test papers: Make strips of Whatman # 1 filter paper by cutting in ½ inch widths, 3½ inches long. Using a dropper, place three dots (size of large pea) along the length of the paper. The dots will be blue colored. Now coat the middle dot with just enough of complexing solution 2b to wet the whole dot. Coat an end dot with complexing solution 2a in the same manner. Always coat with care to use about the same amount of complexing solution since this solution varies the sensitivity of the spots. The uncoated dot (dot # 1) is the most sensitive and changes to full wine red if wet with a solution containing 10 ppm. of Mg. The middle dot (dot # 2) (coated with 2b) starts to turn wine red with around 20 to 30 ppm. of magnesium and is a full wine red at about 50 ppm. The last dot (dot # 3), coated with 2a, is the least sensitive and starts to change to a wine red at around 100 ppm. of magnesium. The papers should be stored in air-tight, dark container.

Making the test: Press the plant sap out of a succulent part of the plant onto a spot with the aid of a pair of pliers. Then apply solution # 3 to buffer any acidity.

Interpretation: If the plant sap does not produce any trace of red color on dot # 1, the sap contains less than 1 or 2 ppm. of magnesium. A fair amount of wine-red color is obtained at 5 ppm. and a full wine red at 10 ppm. Plants grown in culture solutions without magnesium or on soils very highly deficient in magnesium do not turn dot # 1 red. S. W. Melsted found that the sap from magnesium deficient hothouse grape leaves did not turn dot # 1 wine red, while the magnesium treated grape leaves did. Magnesium

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LADINO CLOVER

Its Mineral Requirements and Chemical Composition*

By Ivan Stewart, Research Fellow, and Firman E. Bear, Research Specialist, Soils[1]

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LADINO is recognized as one of the most desirable pasture plants. Its superior feeding qualities are due to its high content of protein, minerals, and vitamins and to its continuous palatability. It recovers rapidly following mowing and grazing, is relatively free of disease, and is valuable as an aid in maintaining the nitrogen supply in soils and in controlling erosion.

Ladino was developed in the 18th century in Italy from common white clover brought from Holland. The large variety became most popular on the irrigated plain of Lodi along the Po River. There it is called "trifoglio bianco gigante Lodigiano," frequently reduced to "ladino Lodigiano." The origin of the word "ladino" is not clear. In certain northern Italian dialects, ladino means "easy" or "fluent." The word may refer to easily worked, loose, sandy soils that give a luxuriant growth of white clover under irrigation.

First Seedings in the United States Failed

Ladino was introduced into the United States in 1894, but the early seedings were unsuccessful. Not until ladino was tried in the far West did it establish its hold in this country. There the dry climate and fertile irrigated soil are ideal for this crop. Most of our seed is now produced in Washington, Oregon, and California.

Within recent years, wide search has been made for pasture legumes that give high acre yields under intensive management. Ladino is the most promising one so far discovered. It is now grown extensively in every state except North Dakota. About 4 million acres were planted to ladino, alone or in mixtures, in 1949. California led all states with 587,000 acres, while Ohio and New York each had 500,000. The first plantings in New Jersey were made in Sussex County in 1937. In 1949 New Jersey had 80,000 acres of ladino, equivalent to 70 per cent of the rotation pasture land in the state.

Except for size, ladino is very similar to common white clover. It possesses thick, fleshy stolons that radiate from a crown. It has two well-developed root systems: a taproot at the crown, and adventitious roots at the stolon nodes. Most of its roots are

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[1] The authors wish to thank S. D. Gray, Northeast Manager of the American Potash Institute, for many helpful suggestions during the course of this study, and the Institute for partly financing this work.

in the plow depth of soil, but some of them may extend downward to a depth of 5 feet.

The upright growth of ladino consists entirely of unbranched leaf and flower petioles that grow directly from the crown of the plant or from the nodes of the stolons. Leaves and petioles are free of hairs. The undersides of the leaflets commonly have a waxy or shiny appearance that distinguishes this plant from red clover. Most of the leaves have water markings that make them readily distinguishable from those of alsike clover.

Ladino seeds are heart-shaped, approximately 1 mm. long, and range from bright yellow to yellowish brown. About 680,000 seeds weigh 1 pound. If planted at the rate of 2 pounds an acre, there would be 32 seeds for each square foot.

Ladino Has a High Nitrogen and Mineral Content

Ladino is high in nitrogen and mineral elements. Average contents of these elements in New Jersey ladino are shown in Table I. Of the elements listed, Na, Cl, Si, Ni, I, and Co are not known to be needed by ladino. The consuming animal requires all of them except Si, Ni, and Mo.

Ladino contains higher percentages of K than of any other mineral element. Since most of its root system is in the upper few inches of soil, success in growing ladino apparently depends largely on the supply of this element in available form in the topsoil.

Fertilizer and Other Requirements of Ladino Studied

Field, greenhouse, and laboratory studies were made to determine fertilizer and other requirements of ladino. The field area consisted of approximately 1 acre of Nixon loam. It had been sown to red clover and timothy in the spring of 1941 and had remained in these crops until the summer of 1944, when it was plowed, prepared, and seeded to ladino. The drouth of that summer prevented a successful stand, and the field was reseeded in August 1945.

Calcitic limestone was applied to the entire area at the rate of 3½ tons an acre. Of this, 1½ tons were applied in 1944 and the remainder in 1945. This raised the pH value of the plow depth of soil to approximately 6.5. During 1946, the hay was harvested and removed. In 1947, the area was divided into 25 sets of triplicated plots. Fertilizer was applied to some of these plots in the early spring of 1947. Other plots received topdressings immediately after the first or second crop of each growing season had been harvested.

Cuttings were made and recorded on June 17, July 24, and August 25, 1947; June 10, July 15, and August 30, 1948;

TABLE I.—NITROGEN AND MINERAL CONTENT OF NEW JERSEY LADINO *

In pounds a ton dry matter

Element	Symbol	Content	Element	Symbol	Content
Nitrogen	N	74	Iron	Fe	0.60
Potassium	K	60	Manganese	Mn	0.18
Calcium	Ca	30	Boron	B	0.11
Sulfur	S	20	Zinc	Zn	0.10
Chlorine	Cl	20	Copper	Cu	0.024
Silicon	Si	10	Nickel	Ni	0.003
Phosphorus	P	6	Iodine	I	0.002
Magnesium	Mg	6	Molybdenum	Mo	0.002
Sodium	Na	4	Cobalt	Co	0.0002

* Average chemical analysis of ladino grown in New Jersey.

TABLE II.—DISTRIBUTION OF RAINFALL * FOR 1947, 1948, 1949, AND 1950, BY 10-DAY PERIODS THROUGHOUT THE GROWING SEASON

In inches

Period†	March	April	May	June	July	August	Sept.	Oct.	Nov.
1947									
1–10	1.43	2.82	2.97	1.77	1.76	0.87	1.09	0.04	4.62
11–20	0.52	0.73	1.25	0.82	3.31	1.76	0.34	0.06	1.76
21–30	0.38	0.63	2.41	0.48	0.94	0.22	0.66	2.05	0.78
1948									
1–10	1.99	1.64	2.09	0.58	1.06	3.05	1.03	0.41	1.29
11–20	0.68	1.32	2.49	4.02	1.42	1.31	0.25	0.56	0.58
21–30	0.81	0.29	2.05	2.08	1.36	3.15	0.36	0.44	1.39
1949									
1–10	0.80	1.51	2.62	.....	0.30	0.43	2.19	0.07	0.32
11–20	1.05	1.25	1.20	0.02	3.62	1.33	1.06	.....	0.40
21–30	0.89	0.93	0.86	.....	0.05	1.20	1.70	2.53	0.47
1950									
1–10	0.42	0.22	0.61	1.27	5.65	2.02	0.22	0.32	1.40
11–20	0.78	0.58	1.33	0.56	0.89	1.13	1.42	0.17	0.10
21–30	2.33	1.39	0.93	0.45	0.24	1.42	0.12	0.93	3.60

* Total for 12 months, 44.78 in., 1947; 49.69 in., 1948; 39.08 in., 1949.
† The period 21-30 was 21-31 in months containing 31 days.

and June 6, 1949. A 52-day drouth (Table II) prevented any further harvesting in 1949 and ruined the stand. Each cutting was made when the ladino was 7 to 9 inches high. The portion harvested consisted of a swath 5 feet wide and 43.56 feet long, a total area of 0.005 acre. The entire swath was weighed as cut, and a sample was taken for moisture determination. Weights are recorded on a dry-matter basis (Table III). In terms of field-dried hay, the yields would have been 10 per cent higher. Samples for chemical analysis were dried at 70°C. in a forced-draft oven. They were analyzed for the elements indicated by standard chemical laboratory procedures.

Potassium Needed for High Yields

As analyses had indicated, K was the most important fertilizer element. Compared with check plots, yield increases of 9, 18, and 20 per cent were obtained from annual topdressings of 60, 120, and 180 pounds K_2O an acre, respectively. Deficiency of K was evident the first year on the check plots, although 100 pounds of K_2O an acre had been applied to the entire area a little more than a year before the start of the test.

This is in line with results of a recent survey of ladino on 23 widely distributed farms in New Jersey. Chemical analyses, both of the soils and of the ladino growing on them, indicated that insufficient K was generally the reason for poor stands. Fortunately, when ladino plants contain less than 1 per cent K on the dry-weight basis, white specks appear on the outer edges of the leaves (Fig. 1) and warn the observing farmer that more K is needed. Unless K is supplied, the leaves turn yellow, and the plants soon become so weakened that weeds and grass take over.

Because of its shallow root system, ladino needs a readily available supply of K in the plow depth of soil. In light soils, heavy initial applications are likely to become leached beyond the reach of the ladino roots. At the end of 3 years, ladino plots that had

TABLE III.—THREE-YEAR YIELDS OF LADINO AS INFLUENCED BY KIND, AMOUNT, AND DATE OF APPLICATION OF FERTILIZER TOPDRESSINGS

In pounds dry matter—mean of three replications

Treatment			Acre yield									
			1947				1948				1949	3-yr. Total
No.	Elements*	Time†	June 17	July 24	Aug. 26	Total	June 10	July 15	Aug. 30	Total	June 6	
1	KB	AFC	1520	1030	480	3030	1580	1300	660	3540	2090	8660
2	PB	AFC	1600	1030	440	3070	1020	1120	460	2600	1630	7300
3	KPB	ES	1620	1150	490	3260	1550	1400	600	3550	1940	8750
4	KPB	AFC	1550	1090	530	3170	1470	1290	610	3370	2110	8650
5	KPB	ASC	1520	1060	500	3080	1610	1260	700	3570	1900	8550
6	KPB‡	ES–AFC	1480	1170	480	3130	1260	1370	650	3280	1930	8340
7	2KPB	AFC	1510	1060	500	3070	1520	1380	730	3630	2200	8900
8	3KPB	AFC	1570	1080	500	3150	1610	1340	710	3660	2350	9160
9	KPBNa	AFC	1600	1070	530	3200	1230	1330	650	3210	2000	8410
10	KPBN	ES	1610	1090	410	3110	1290	1140	690	3120	2060	8290
11	KPBN	AFC	1480	1080	460	3020	1190	1330	630	3150	1870	8040
12	KPBN	ASC	1680	950	470	3100	1420	1290	760	3470	1760	8330
13	2KPBN	AFC	1610	1050	520	3180	1610	1410	720	3740	2020	8940
14	KPBNNa	AFC	1520	920	460	2900	1450	1360	630	3440	2090	8430
15	2K2PB	AFC	1630	1080	540	3250	1410	1320	720	3450	2060	8760
16	2K2PBMg	AFC	1500	1180	600	3280	1510	1430	700	3640	2140	9060
17	2K2PB2Mg	AFC	1350	1150	490	2990	1560	1300	610	3470	2040	8500
18	KPB2Mg	AFC	1510	1070	430	3010	1430	1340	570	3340	1890	8240
19	2K2PBCa	AFC	1540	1040	480	3060	1620	1370	640	3630	2210	8900
20	2K2PBMo	AFC	1530	1030	450	3010	1470	1300	730	3500	2140	8650
21	2K2P	AFC	1460	1100	430	2990	1290	1330	670	3290	2040	8320
22	KP	AFC	1520	970	470	2960	1430	1320	590	3340	1930	8230
23	———	———	1700	910	380	2990	1070	1050	360	2480	1720	7190
24	5K5P	STO	1740	1170	530	3440	1220	970	530	2720	1400	7560
25§	2K2PB	AFC	3040	1100	570	4710	2960	1160	830	4950	2360	12020

* Per acre: K = 60 pounds K_2O; P = 60 pounds P_2O_5; N = 60 pounds N; B = 20 pounds borax; Na = NaCl equivalent to K; Ca = 1,000 pounds $CaCO_3$; Mg = 160 pounds MgO as $MgSO_4.7H_2O$; Mo = 5 pounds Na_2MoO_4.

† AFC = after first crop; ASC = after second crop, ES = early spring, STO = seeding time only.

‡ P and B in early spring; K after first cutting.

§ Mixed seeding of ladino, alfalfa, and timothy.

received annual topdressings of 60 pounds K_2O an acre yielded 14 per cent more hay than other plots to which a single application of 300 pounds K_2O an acre had been made at seeding time (Table IV).

The most favorable time for topdressing ladino was in early spring. This is because ladino yields almost as much in the spring flush as during all the rest of the season. Ladino has a high moisture requirement and is favored by the damp soil at that time of the year. Addition of K before the grazing season begins makes it possible to graze ladino earlier and more frequently.

The plow depth of an acre of average soil weighs approximately 2 million pounds. The total amount of K in that weight of 20 important New Jersey soils was found to range between 1,400 and 85,000 pounds, the average being about 35,000 pounds. The percentage K increased with depth in 13 of these soils. The portion of a soil's total K that is available for crop use during any one year is relatively small, commonly not more than ¼ per cent. Most of the soil's natural supply of K is contained in the interior of the mineral particles, where it is protected

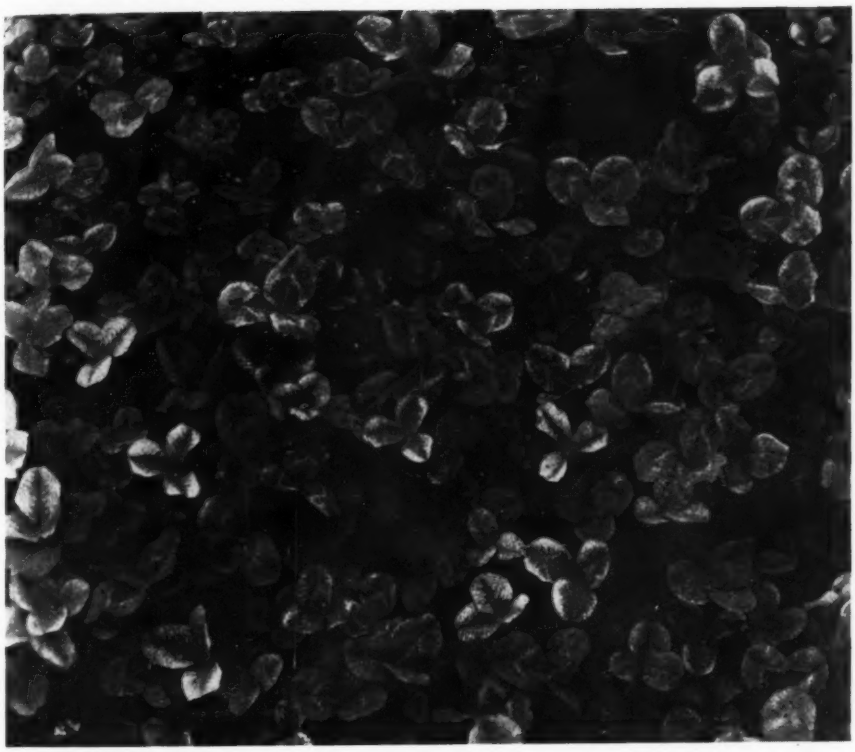

Fig. 1. White spots on leaves indicate potassium deficiency.

against the solvent action of soil water and the absorptive action of plant roots. Only the part that is exposed on the surfaces of the particles, which is known as "exchangeable K," and the small amounts that are dissolved in the soil water are at the immediate disposal of plant roots. Repeated wetting and freezing and thawing of the soil tend to aid in increasing its supply of available K for crop use.

The 100-pound-an-acre application of P_2O_5 made prior to the final seeding of the ladino supplied sufficient P for the 4-year period of hay production on this soil. The evidence on topdressing ladino, when grown for hay or silage as in this study, indicates the desirability of using fertilizer grades containing considerably higher percentages K_2O than P_2O_5.

Ladino is more tolerant of acid soils than is alfalfa. But if the pH value of the soil is less than 6.0, yields of ladino can usually be increased by applications of lime. In the greenhouse, however, ladino yields were equally as large at a soil pH value of 4.4 as at higher values, provided a trace of Mo was added. This indicates that lack of available Mo may be a limiting factor in growing ladino on acid soils. No yield increases were obtained from an annual application of 5 pounds sodium molybdate an acre on the liberally limed soil in the field tests (Table III). But the Mo content of the hay was increased from 0.4 to 6.9 ppm. This was a heavier rate of application of Mo than may be desirable in practice.

Overliming may cause a deficiency of Mn. Ladino taken from an overlimed field, where Mn-deficiency symptoms had been noted on alfalfa and red clover, contained only 14 ppm. Mn,

TABLE IV.—EFFECT OF INCREASING INCREMENTS OF K AND OF TIME OF APPLICATION OF PK AS TOPDRESSINGS ON YIELD OF LADINO OVER A 3-YEAR PERIOD

Plot	Treatment*	Time†	Acre Yield			
			1947	1948	1949	Total
			lb.	*lb.*	*lb.*	*lb.*
		Increasing increments of K				
2	P	AFC	3070	2600	1630	7300
4	PK	AFC	3170	3370	2110	8650
7	P2K	AFC	3070	3630	2200	8900
8	P3K	AFC	3150	3660	2350	9160
		Time of application of PK				
3	PK	ES	3260	3550	9140	8750
4	PK	AFC	3170	3370	2110	8650
5	PK	ASC	3080‡	3570	1900	8550
6	PK	ES–AFC§	3130	3280	1930	8340
24	5P5K	STO	3440	2720	1400	7560

* All plots received standard applications of borax. P = 60 pounds P_2O_5; K = 60 pounds K_2O.
† ES = early spring; AFC = after first cutting; ASC = after second cutting; STO = seeding time only.
‡ Received first topdressing September 9, 1946. None of the other plots were topdressed until 1947.
§ P in early spring, K after first cutting.

whereas it normally contains between 50 and 100 ppm. Although the ladino in this field showed no Mn-deficiency symptoms, growth was probably retarded, and the value of the crop for livestock feeding may have been lowered.

Many New Jersey soils are low in water-soluble B. The critical level for soil B has been set at 0.35 ppm. Applications of borax at seeding had raised the water-soluble B content of the field soil under test to 0.9 ppm. As a result, no yield increases were obtained from the supplemental use of borax as a topdressing.

B-deficiency symptoms in ladino are not easily recognized in the field. In many instances the only evidence is reduced yields. In severe deficiencies, the leaves turn red and then yellow. Similar symptoms often result from Mg deficiency and insect injury. In extreme B deficiency, some of the ladino leaves fail to develop normally (Fig. 2).

Applications of Mg, up to the equivalent of 160 pounds MgO an acre, gave small but definite yield increases. Mg is one of the essential constituents of chlorophyll. If the supply of this element is inadequate, the margins of the older ladino leaves turn red and the interveinal regions become yellow, while the veins remain dark green.

Except in peat soils, Cu is not known to be deficient in New Jersey. But the Cu content of ladino can readily be increased by applications of this element to the soil on which the ladino is growing. Topdressing with 10 pounds copper sulfate an acre increased the Cu content of ladino from 12.5 to 20.2 ppm.

The Zn content of ladino normally ranges from 40 to 60 ppm. The amount of this element available to plants is largely dependent on the pH of the soil, Zn being more soluble in acid than in well-limed soils. Some ladino samples taken from heavily limed soil in New Jersey contained as little as 18 ppm. Zn.

Fig. 2. Extreme boron deficiency prevents normal development of ladino leaves. Left, leaf from boron-deficient ladino plant; right, leaf from normal plant.

Ratio of Ladino to Grass Important in Mixtures

One of the major problems confronting farmers is that of keeping a proper ratio of ladino to grass in pastures. Increasing the proportion of grass in a mixture usually results in increased yields, but it may lower the feeding value. Increasing the percentage of ladino usually lowers yields and may cause trouble from bloat.

To determine the extent to which fertilizer could be useful in controlling ladino-grass ratios, 18 treatments were tested on small plots of Sassafras sandy loam. Each plot was separated by boards that extended approximately 10 inches below the surface of the ground. The soil used in this study contained 170 pounds exchangeable Mg, 35 pounds exchangeable K, and 20 pounds available P an acre and had a pH value of 5.5. In preparation for the test, the soil was treated with methyl bromide for 24 hours to kill weed seeds. All plots received 200 pounds P_2O_5, 20 pounds borax, and 1 ton dolomitic limestone an acre. N and K were the only variables in the fertilizer treatments. Half the N and all the K were applied at the time of planting, May 29, 1950 (Table V). The remaining N was applied August 8.

Ladino and orchard grass plants were obtained from a field that had been seeded the previous September. The roots were washed. Those of the ladino plants were dipped in an inoculating culture. Eighteen plants were equally spaced in each plot, two in each square foot. One third of the plots were planted to ladino, one third to orchard grass, and the remaining plots to an equal number of ladino and orchard grass plants. The plots were harvested July 8, August 8, August 29, and October 17. The ladino and grass from the mixed plots were harvested separately.

Applications of N had little effect on pure stands of ladino, but they greatly stimulated the orchard grass. Yields of orchard grass were increased 40 per cent by the N when the grass was grown in a mixture with ladino and 44 per cent when it was grown alone.

Considerably higher yields were produced on a unit area of land when the two were grown in a mixture over an entire area than when each was grown separately on the two halves of an equal area. Apparently the N fixed by the ladino was responsible for the increase in yield of the associated orchard grass. The yields of ladino were decreased by growing it with orchard grass.

The ratio of ladino to orchard grass was readily controlled by regulating the amounts of N and K that were used for topdressing (Table VI). When no N was used, the percentage ladino in the mixture, on a dry-weight basis, was much higher than when N was applied (Figs. 3 and 4).

The orchard grass contained higher percentages K, P, S, and Mn and lower percentages Ca, Mg, Na, and Fe than the ladino (Table VII). Ladino removed 118 pounds K an acre in four cuttings from plots receiving the heaviest K treatments and no N. Orchard grass took up as much as 202 pounds K an acre from plots treated with N and the largest quantity of K (Table VIII). Reduction in dry-weight yields of ladino in mixtures fertilized with N results from the competition of the grass for K.

To broaden the study of mineral competition among species, samples of ladino and orchard grass were taken from adjacent areas in pastures in seven states. All samples were collected over a 10-day period. The mineral content (Table IX) of both species varied considerably. The K content of ladino varied between 1.8 and 2.9 per cent. That of orchard grass was much higher, varying between 2.6 and 4.5 per cent. Percentages of Ca and Mg were generally much higher in ladino than in orchard grass.

Comparative Study Made of Ladino's Two Root Systems

Ladino has two well-developed root systems, each of which plays a role in the mineral nutrition of the plant. A taproot is the only means of support for a ladino seedling. Adventitious roots develop later on stolons of mature plants.

For a better understanding of the functions of these two root systems, movement of K and radioactive Na through the stolons was studied. The taproot of a ladino plant was grown in one pot and one of the stolons was allowed to produce adventitious roots in another pot. By this means it was found that the amount of K present in the growing point of the stolon was primarily dependent on the K concentration in the pot where the adventitious roots were growing, rather than that in the pot where the taproot was. By using radioactive Na, it was shown that minerals can move in either direction in the stolons. Under field-like conditions, however, virtually all of the minerals taken up by the adventitious roots were translocated to the growing point of the stolon.

Adventitious roots grew at the rate of 6.5 mm. a day in a complete nutrient solution low in K. With higher K concentrations, the rate of growth increased to 11 mm. a day. In both cases, the taproots had been given what is normally considered an adequate supply of K. This indicates the importance of a liberal supply of available K for good root growth of ladino.

When adventitious roots were prevented from growing on stolons, a large taproot system was formed. In proportion as the adventitious roots were allowed to grow, the taproot system tended to deteriorate.

Starch Storage in Ladino Fluctuates Widely

Following harvesting, new top growth of hay and pasture plants is initiated at the expense of previously stored reserves of starch. Unless such reserves are sufficiently replenished between cuttings, the amount of new top and root growth progressively di-

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Magnesium Soils of Hawaii Need Potash

By G. Donald Sherman

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THE sticky plastic black soils of the Hawaiian Islands are often called "magnesium soils" because of their high content of exchangeable magnesium. The poor physical condition of these clay soils appears to be related to their percentage magnesium saturation. Any slightly acid, neutral, or alkaline clay soil having a magnesium saturation greater than 30 per cent (exchangeable magnesium makes up more than 30 per cent of the exchangeable cations of the soil), will exhibit properties of an alkali soil, such as, ease of dispersion, stickiness, plasticity, etc. The black color of these soils is not due to a high content of organic matter, but is due to the dispersed condition in which organic matter exists in these soils. When the magnesium saturation is less than 25 per cent in Hawaiian soils, they do not exhibit this poor physical condition and are red in color. The red color in these soils is due to the fact that the organic matter is not dispersed.

The "magnesium soils" exhibit many undesirable physical properties. When they are dry, the soil cracks open into very large and deep cracks. The soil between the cracks forms a dense, compacted, irregular-shaped clod often as large as a cubic foot. In a wet condition these soils are easily puddled to the extent that internal drainage ceases. The movement of irrigation water in the furrows or the agitation of the soil during heavy rainstorms often causes sufficient puddling of the soil so as to restrict the internal drainage of the soil. As these moist, partly puddled soils dry out, a crust-like layer forms at the surface causing a lack of aeration in the soil.

The "magnesium soils" belong to several soil groups. The soils of the dark magnesium clays, gray hydromorphic, paddy, old alluvial, and the black soil of the "red and black complex" of the low humic latosol (lateritic) exhibit the physical properties of "magnesium soils." All of these soils have a high content of exchangeable magnesium. Similar soils have been described in other tropical regions and in many cases these soils of other tropical areas have a high content of exchangeable magnesium. The soils belonging to the dark magnesium clay group and the black soil of the "red and black complex" are very similar to the tropical black soils of other areas. The clays of all types of Hawaiian "magnesium soils" are of the montmorillonite type.

Management Problem

In the Hawaiian Islands the management of the "magnesium soils" is a serious problem. It is necessary in many areas to use an irrigation water having a high content of magnesium and, as a result of this practice, the area of "magnesium soils" is increasing. In addition the surface water often contains more magnesium than calcium due to the weathering of the magnesium-rich olivine basalts of higher elevations. As a result of these sources of magnesium to the soil, the percentage magnesium saturation ranges from 30 to 80 per cent in the soils of the semi-arid lowlands and certain semi-arid uplands of the Islands.

In addition to the difficult physical problems, the "magnesium soils" are very deficient in potash. The potash deficiency on these soils is so severe that

light applications of a potash fertilizer will not show much improvement in the crop growth. Satisfactory plant growth can only be obtained after the application of large quantities of potash. The level of available potassium, which ranges from 300 to 600 pounds per acre, would however appear to be adequate. The history of the growth of crops on these soils will give an entirely different picture. The crops will grow normally at first, but after about six weeks to three months a severe potash deficiency will develop.

If sudan grass is grown on these soils, usually the first crop will show little or no difference between the growth of the grass on the soil receiving potash fertilizer and on the soil receiving no potash fertilizer. The growth of the first ratoon crop will be quite different. The growth of the sudan grass on the soil receiving no potassium fertilizer will be from one-fourth to one-tenth of that obtained on the soil receiving a potash fertilizer. The difference usually becomes greater with each succeeding ratoon.

Figure 1 shows the general trend of yields of sudan grass on the black low humic latosol soil of the "magnesium soils" which has received a potash fertilizer. The fertilized soil outyields the soil which received no potash fertilizer. In Figure 2 is shown a comparison of the growth of sudan grass on a "magnesium soil" receiving no potash fertilizer and on soil receiving potash fertilizer. The difference is very striking.

One will notice that in Figure 1 there is a difference in yield of the first crop between that obtained on a soil receiving no potash fertilizer and the soil receiving potash. The reason is that sudan grass was sown on this soil immediately after the removal of the preceding celery crop. If the land had been fallowed for a period of a month or six weeks prior to the seeding of the sudan grass, the yield of the two treatments would have been almost equal for the first crop. The level of

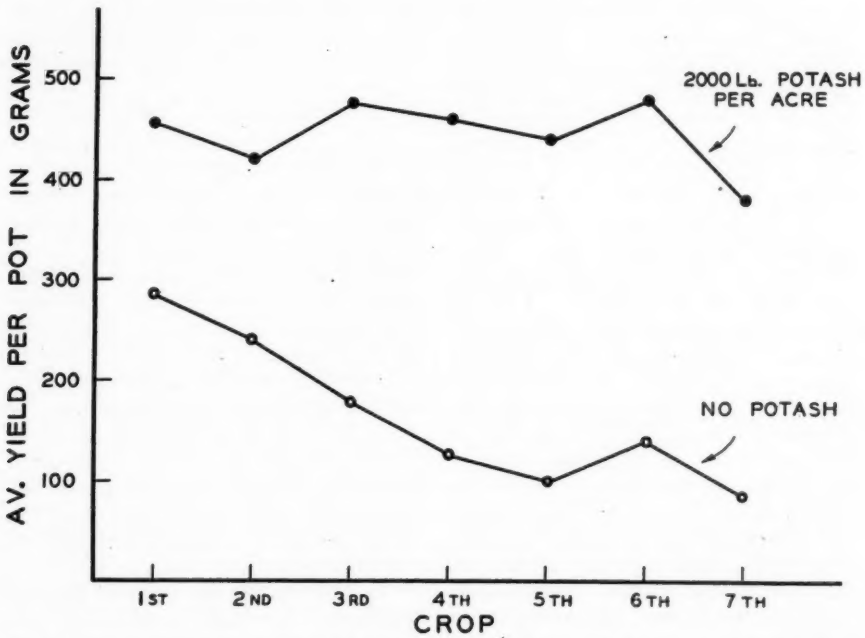


Fig. 1. The relative yields of sudan grass grown on a magnesium soil receiving no potash as compared to the heavy application of potash fertilizer.

Fig. 2. The influence of the application of potash fertilizers to magnesium soils on the growth of sudan grass. The two pots on the left received no potash; the two pots on the right received 1,000 pounds of potash per acre.

the available potash builds up during the time the soil lies fallow.

The evidence has been established that in any soil or nutrient solution having a high content of magnesium, the intake of potassium by plants will be reduced. If more potassium is added to such growing media the plants will grow normally. Thus, in these "magnesium soils" the high content of exchangeable magnesium, 10 to 50 milliequivalents per 100 grams, interferes with the normal intake of potassium from the soil. The data on hand indicate that when the ratio of exchangeable magnesium to exchangeable potassium exceeds five to one, one can expect to have potassium deficiency. In most of these soils the ratio of exchangeable magnesium to exchangeable potassium ranges from ten to one, to fifteen to one. The five to one ratio may prove to be too low when more information is obtained on the performance of these soils.

The influence of the high content of exchangeable magnesium on the potassium intake by plants is shown in Table I. The plants on the soil receiving no potash fertilizer had an average potassium content of little over 0.4 per cent,

TABLE I. THE INFLUENCE OF LIME ON THE YIELD OF SUDAN GRASS AND ON THE UPTAKE OF ADDED POTASH.

Treatment	Yield av. of 5 pots grams	Chemical composition of sudan grass		
		Ca per cent	Mg per cent	K per cent
No lime + no potash	167	0.90	0.85	0.40
No lime + K 2,000 lbs./acre	338	0.41	0.31	2.10
2 tons of lime + no potash	182	0.78	0.68	0.42
2 tons of lime + K 2,000 lbs./acre	383	0.40	0.30	2.61
4 tons of lime + no potash	175	0.94	0.74	0.44
4 tons of lime + K 2,000 lbs./acre	378	0.51	0.30	2.42
8 tons of lime + no potash	163	1.15	0.74	0.47
8 tons of lime + K 2,000 lbs./acre	384	0.53	0.31	2.51

while the plants grown on the soil receiving 2,000 pounds of potassium per acre had over 2.25 per cent potassium in their tissue. The application of lime to these soils will not improve the potash picture. There is evidence that it does improve the intake of added potash from the fertilizer.

The management of "magnesium soils" is a difficult problem. The present management which appears to give good results is as follows:

1. ***Deep plowing:*** The subsoils of the "magnesium soils" usually have a high content of gypsum. By plowing to depths of 14 inches or deeper, the subsoil containing the gypsum can be brought to the surface. The addition of the gypsum soil to the surface improves the over-all physical condition of the soil.

2. ***Soil amendments:*** The experiments with different soil amendments have not proven as fruitful as one would expect. The addition of gypsum has been beneficial but not as beneficial as deep plowing. The addition of acid-forming material such as sulfur followed by flooding and then an application of lime has given the best experimental results, however, this treatment is not very practical. The addition of lime will improve soil structure, but the required applications are very heavy and usually cause other nutritional troubles. Some beneficial results have been obtained from the application of sugar mill wastes such as mud press. These materials are high in lime and organic matter. In general the soil amendments have not been used because the results to date do not justify their use.

3. ***Drainage:*** Tile drains have been installed in some areas. Locally they do improve the soil by the removal of the excess salts. From a practical viewpoint the tile drains do not drain a large enough area to justify their use. Drainage is very desirable especially when one realizes that some of these areas receive per year as much as 105 acre-inches of irrigation water containing 1,100 parts per million of salts.

4. ***Field cultivation:*** Cultivation which increases the aeration of the soil is very beneficial. Observations of the growth of plants where good aeration is maintained indicate that in a well-aerated soil the severity of the potash deficiency is much less.

5. ***Potassium fertilization:*** Fundamentally, the problem in these soils

(*Turn to page* 47)

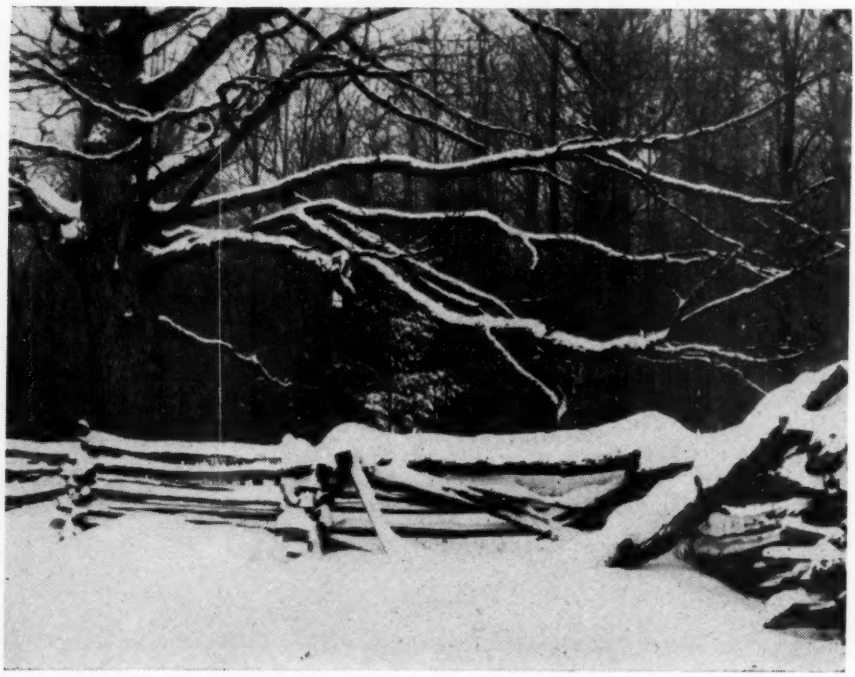
Fig. 3. The stunted growth of sugar cane in this picture is due to high content of exchangeable magnesium in the soil. The plants have typical symptoms of potash deficiency.

PICTORIAL

A Start in Good Management

Above: **Sheep in San Benito County, California**

Below: **Most anywhere this winter.**

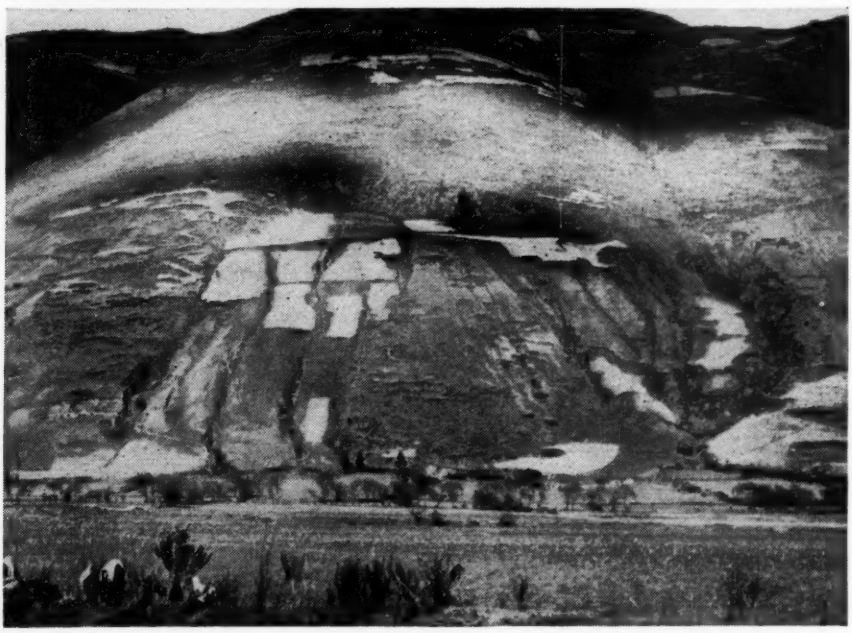


Above: This highway is really well blocked.

Below: A well-kept orange grove.

Above: **"Stair-step" farming near Macchu Picchu, "Lost City" of the Incas, about 90 miles northwest of Cuzco, Peru. The stone terraces are about five feet high.**

Below: **The modern Indian, descendant of the Inca, still farms the same land used by his ancestors. Little patches of wheat are planted between the gullies on the steep mountain slopes.**



The Editors Talk

Our Cover Picture

In this issue of the magazine, we are starting a series of colored illustrations showing nutrient deficiencies on various crops. It is hoped that these will help agricultural advisers, teachers, and others in their work by enabling them to become more familiar with some of the characteristic abnormalities of plants suffering from insufficient plant food. As these symptoms of nutrient deficiencies are recognized and identified, it will sometimes be possible to correct the deficiencies for the currently growing crop. Certainly, information for more intelligent future fertilization of the field will be provided.

It is highly important to keep in mind that in the case of the major elements, and in most cases of the minor elements, one should not wait for these deficiency symptoms to be exhibited before applying fertilizers. When the crop is so starved that it shows these signs, it is indeed in a bad way. Long before conditions become so acute, yield and quality have been adversely influenced.

The illustration on the cover of this issue shows a striking case of potash deficiency on potatoes at Aroostook Farm, Presque Isle, Maine. At this farm is to be found one of the most comprehensive soil-fertility experiments on potatoes in this country. After 25 years of continuous cropping, the yield and quality differences resulting from differential treatments provide visual and statistical information of unquestioned value. One look at the no-potash plot, for example, is quite revealing. Comparison of the low, medium, and high potash fertilized plots leaves no doubt as to the importance of this plant nutrient in potato production.

Potash deficiency in potatoes is first revealed by retarded growth. The internodes are somewhat shortened, giving the plant a compact appearance. The leaves are reduced in size owing to narrow arrangement of the leaflets which form a sharp angle with the stem. The leaves lose their smooth surface, become crinkled, and droop. Early appearance of abnormally dark green foliage is one of the best indications of potash hunger.

Later, the older leaves become yellowish and a brown or bronze color develops, starting from the tip and edge and gradually affecting the entire leaf, which finally dies. In a single plant this bronzing is not so striking, but over the field it is quite prominent. Under certain light conditions, a distinct purplish cast is apparent. The lower leaves may dry up at the same time, leaving a tuft of dark green leaves at the top of the plant. Eventually the entire plant dies.

Important as the recognition of potash-deficiency symptoms on the potato crop is, one should not depend upon their appearance before supplying adequate potash in the form of fertilizer. If the potash supply is not maintained at an optimum level, both yield and quality will suffer. In a recent experiment in Maine where the basic fertilizer application was 2,000 lbs. of 6-9-9 fertilizer per acre, omitting phosphorus or potash and all but 1½ per cent nitrogen for the year 1949 resulted

in decreased yields of 54, 77, and 182 bushels, respectively. In another experiment on a low-potash soil (less than 300 lbs. available potash per acre in the surface 6 or 7 inches) with the same basic application as above, the omission of potash from 1946-1950 showed progressive decreases in yield of from 249 bushels in 1947 to 465 bushels in 1950. On another soil having a level of more than 500 lbs. of available potash, yields showed progressive decreases of only 63 bushels the first year and 145 bushels the last year of the experiment.

All-out Again in 1952

Again, American farmers are being asked to produce as they never did before. The goals set for 1952 call for increases in the production of most crops, with particular emphasis on the feed grains in order to meet the high and expanding demand for livestock products. Not only are these goals based on the requirements of our partial mobilization and defense operations but on the demands of the 2½-million annual increase in our population and a 13% increase above the 1935-39 average in per-capita food consumption due to high civilian purchasing power. Added, too, must be the food requirements of the friendly nations.

The agricultural advisory forces are going to be hard put to answer all of the problems of their constituents. "No more land to put under cultivation, shortage in labor supplies, increasing costs—how are we going to do it?" Greater efficiency is the over-all answer.

The U. S. Department of Agriculture says that farmers will need to make the best possible use of every acre without hurting its long-time productivity. Some acres now in poor stands of hay and pasture will produce more feed if planted to feed grains. But more attention should be given to conservation and improvement measures on grasslands to relieve the pressure on feed supplies. Only 10-15% of the Nation's grasslands are now under fully improved management. Much of this grassland acreage could produce several times more forage for livestock if sufficient fertilizer and other necessary materials are employed.

The yield of food, feed, and fiber crops per acre has gone up about 40% since the early 1930's, despite fewer farm workers. Farmers are using 80% more and better machinery and 3½ times as much fertilizer as they did in 1935. Further increases are possible through greater efficiency on more farms in the use of fertilizers; improved farm machinery; electrical power and equipment to supplement the dwindling manpower supply; better insect, disease, and weed controls; improved seed varieties; and better land- and water-use practices in general. For specific local information on these matters, the Department is referring growers to their County Agent and other members of the County Agricultural Mobilization Committees.

G. B. Whitman, Farm Management Specialist, Illinois College of Agriculture has some good suggestions on offsetting rising costs. "Use fertilizers—they're cheap at present prices," he says. "Feed balanced rations. Use seed treatments, insecticides, sprays, and dusts to control insects and diseases. Do custom work to get a cash income from labor and machinery that are not otherwise busy. Feed livestock regularly and accurately, operate and adjust machines and equipment carefully and be thorough and eliminate carelessness in all farm work. Hire only the labor you need, simplify all jobs you can, exchange labor."

The resourcefulness of American farmers has been proven time and again. Barring weather disasters, when 1952 is chronicled for the records, we shall find that this year's goals have been achieved.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1925.....	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926.....	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	1.24	188.0	16.50	43.40	....
1950.....	40.1	51.6	91.6	173.0	153.0	200.0	16.70	86.50	....
1951									
January.....	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March.....	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
April.....	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....
May.....	42.45	39.8	109.0	209.0	164.0	211.0	18.15	101.00	....
June.....	42.02	49.0	108.0	210.0	162.0	208.0	16.85	95.60	....
July.....	39.11	49.5	118.0	219.0	163.0	205.0	15.45	78.00	....
August.....	34.60	47.7	117.0	273.0	165.0	205.0	15.65	69.10	....
September...	33.73	52.4	123.0	287.0	165.0	207.0	16.55	66.10	....
October.....	36.21	57.7	139.0	271.0	164.0	210.0	17.15	69.90	....
November....	41.00	50.0	174.0	280.0	162.0	219.0	18.35	72.70	....
December....	40.34	51.0	193.0	305.0	169.0	222.0	19.65	71.50	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1925.....	158	168	245	188	109	163	108	140	143
1926.....	101	179	189	134	116	138	112	98	139
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	89	81	109	74	87	110
1938.....	69	196	80	79	76	64	57	97	88
1939.....	73	154	100	84	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	105	117	107	82	211	129
1942.....	153	369	168	134	143	124	91	202	163
1943.....	160	405	188	235	174	154	125	231	245
1944.....	167	420	214	216	170	160	139	234	212
1945.....	181	366	205	232	198	170	127	227	207
1946.....	263	382	178	248	212	209	141	319	182
1947.....	257	380	232	248	336	259	148	381	226
1948.....	245	482	222	253	201	226	155	298	214
1949.....	231	459	184	244	193	213	139	192	201
1950.....	323	516	131	197	238	226	141	384	185
1951									
January.....	333	459	141	221	240	236	150	448	324
February....	337	325	148	233	249	250	155	443	333
March.....	345	266	154	236	249	240	155	457	265
April.....	348	253	161	231	252	242	155	457	225
May.....	342	398	156	238	255	239	153	448	239
June.....	339	490	155	239	252	235	142	424	189
July.....	315	495	169	249	254	232	130	346	204
August.....	279	477	168	311	257	232	132	306	181
September...	272	524	176	327	257	234	139	293	161
October.....	292	577	188	309	255	238	144	310	171
November....	331	500	250	319	252	248	155	322	249
December....	325	510	277	347	263	251	166	317	331

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per Unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per Unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53
April	3.13	1.88	13.61	11.50	11.17	11.35
May	3.13	1.88	13.84	10.41	10.09	10.25
June	3.13	1.88	13.53	9.98	8.87	8.50
July	3.13	2.03	12.37	10.06	8.68	8.56
August	3.13	2.07	11.94	10.41	8.66	8.66
September	3.13	2.07	11.50	10.78	9.26	9.26
October	3.13	2.07	12.85	11.28	10.56	10.32
November	3.34	2.07	13.93	11.28	10.39	10.25
December	3.34	2.07	14.27	11.28	10.08	10.02
Index Numbers (1910-14 = 100)						
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328
April	117	66	389	326	331	322
May	117	66	395	295	299	291
June	117	66	387	283	263	241
July	117	71	353	285	258	243
August	117	73	341	295	257	246
September	117	73	329	305	275	263
October	117	73	365	320	313	293
November	125	73	398	320	308	291
December	125	73	408	320	299	285

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[3]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[3]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[3]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[3]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.617	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951							
January	.810	3.98	5.47	.420	.796	16.00	.210
February	.810	3.98	5.47	.420	.796	16.00	.210
March	.810	3.98	5.47	.420	.796	16.00	.210
April	.810	3.98	5.47	.420	.796	16.00	.210
May	.810	3.98	5.47	.420	.796	16.00	.210
June	.810	3.98	5.47	.355	.708	13.44	.176
July	.810	3.98	5.47	.389	.768	14.72	.193
August	.810	3.98	5.47	.389	.768	14.72	.193
September	.810	3.98	5.47	.386	.768	14.72	.193
October	.820	3.98	5.47	.386	.768	14.72	.193
November	.820	3.98	5.47	.386	.768	14.72	.193
December	.820	3.98	5.47	.420	.827	16.00	.210
Index Numbers (1910-14 = 100)							
1925	110	68	126	82	90	98	74
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951							
January	151	110	112	75	84	66	85
February	151	110	112	75	84	66	85
March	151	110	112	75	84	66	85
April	151	110	112	75	84	66	85
May	151	110	112	75	84	66	85
June	151	110	112	65	74	56	80
July	151	110	112	70	81	61	82
August	151	110	112	70	81	61	82
September	151	110	112	70	81	61	82
October	153	110	112	70	81	61	82
November	153	110	112	70	81	61	82
December	153	110	112	75	87	66	85

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950	256	246	236	132	89	314	142	72
1951								
January	300	262	261	140	90	351	151	78
February	313	267	268	141	91	358	151	78
March	311	272	269	142	91	357	151	78
April	309	273	268	141	91	353	151	78
May	305	272	266	139	91	334	151	78
June	301	272	265	134	91	311	151	69
July	294	271	261	135	93	297	151	74
August	292	271	258	135	94	294	151	74
September	291	271	258	135	94	300	151	73
October	296	272	259	140	94	335	153	73
November	301	274	259	143	98	343	153	73
December	305	273	258	144	98	342	153	78

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] All potash salts now quoted F.O.B. mines only; manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Studies of Organic Materials for Vegetable Crops," Agr. Exp. Sta., Ala. Poly. Institute, Auburn, Ala., Bul. 280, June 1951, L. M. Ware and W. A. Johnson.

"Results of Lime and Gypsum Experiments with Runner Peanuts," Agr. Exp. Sta., Ala. Poly. Institute, Auburn, Ala., P.R. Series No. 48, May 1951, F. L. Davis and C. A. Brogden.

"Corn Fertilizer and Spacing Tests 1948 to 1950," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Series 24, May 1951, D. A. Hinkle.

"Soil Improvement Practices Affecting Yields of Cotton," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 513, June 1951, R. P. Bartholomew.

"Fertilizers in Saskatchewan," Agr. Ext. Serv., Univ. of Saskatchewan, Saskatoon, Saskatchewan, Can., Bul. No. 122, Feb. 1951, H. G. Dion and J. Mitchell.

"Liquid Fertilizers — Questions and Answers," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Cir. 374, Sept. 1951, A. J. Ohlrogge and G. F. Warren.

"Fertilizers—Their Purchase and Use on Field Crops," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Cir. 70, June 1951, P. E. Karraker.

"Missouri Fertilizer Consumption 1941-1950," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., P.R. 15, July 1951.

"Commercial Fertilizer Results with Winter Wheat and Rye, 1951," Agr. Exp. Sta., Univ. of Neb., Lincoln, Neb., Outstate Testing Cir. 17, Nov. 1951, G. W. Lowrey, R. A. Olson, A. F. Dreier, and P. L. Ehlers.

"Analyses of Commercial Fertilizers Sold During 1950-51," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Bul. 738, Sept. 1951, J. F. Fudge and T. L. Ogier.

"For Top Pastures—Top Dress," Ext. Serv., Va. Poly. Institute, Blacksburg, Va., Cir. 533, Nov. 1951.

"Release of Native and Fixed Nonexchangeable Potassium of Soils Containing Hydrous Mica," USDA, Wash. D. C., Tech. Bul. No. 1049, Oct. 1951, R. F. Reitemeier, I. C. Brown, and R. S. Holmes.

"Fertilizer and Lime used on Crops and Pasture 1947," USDA, Bur. of Agr. Econ., Washington, D. C., FM 86, June 1951, D. B. Ibach and R. E. Marx.

Soils

"Nutrient Uptake by Soybeans on Two Iowa Soils," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Res. Bul. 384, Aug. 1951, L. C. Hammond, C. A. Black, and A. G. Norman.

"Microorganisms and Their Effects on Crops and Soils," Agr. Exp. Sta., Univ. of Neb., Lincoln, Neb., Cir. 90, Apr. 1951, T. M. McCalla and T. H. Goodding.

"Organic Matter in New Jersey Soils," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 757, June 1951, F. E. Bear and A. L. Prince.

"Diversion Terraces," Ext. Serv., Cornell Univ., Ithaca, N. Y., Bul. 808, Dec. 1950, H. M. Wilson and H. A. Kerr.

"Soil Fertility Conditions in the Apple Orchards of North Central Washington," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Bul. No. 527, July 1951, N. R. Benson and S. C. Vandecaveye.

"Conservation Section for Agronomy Hand Book," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Mimeo. 1088, M. D. Butler.

Crops

"Corn Varieties for Alabama," Agr. Exp. Sta., Ala. Poly. Institute, Auburn, Ala., Mimeo. Rpt. of Results from 1950 Tests, Jan. 1951, E. F. Schultz, Jr.

"Results of 1950 Cotton Variety Tests in Alabama," Agr. Exp. Sta., Ala. Poly. Institute, Auburn, Ala., H. B. Tisdale and A. L. Smith.

"Soybeans in Alabama," Ext. Serv., Ala. Poly. Institute, Auburn, Ala., Cir. 392, March 1951, J. C. Lowery.

"Jim Plants His Trees," Ext. Serv., Ala. Poly. Institute, Auburn, Ala., Cir. 418, Jan. 1951, I. R. Martin.

"Nutritive Studies of Rice," Bul. 508, May 1951, M. C. Kik; "Cotton Production Practices in Arkansas," Bul. 507, Apr. 1951, M. W. Slusher and H. Scoggins; Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark.

"California Grasslands and Range Forage Grasses," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Bul. 724, May 1951, A. W. Sampson, A. Chase, and D. W. Hedrick.

"Winter Covercrops," Ext. Serv., Univ. of Calif., Berkeley, Calif., Cir. 174, June 1951, B. A. Madson.

"The Production of Perennial Grazing and Forage Crops in North Georgia," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Bul. No. 270, June 1951, O. L. Brooks.

"You Can Grow Tomatoes," Ext. Serv., Univ. of Ida., Moscow, Ida., Ext. Cir. No. 116, June 1951.

"Spring Oats for Illinois," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Cir. 679, Apr. 1951, J. W. Pendleton, W. M. Bever, O. T. Bonnett, G. E. McKibben, and P. E. Johnson.

"Long Season Pastures for Illinois," Ext. Serv., Univ. of Ill., Urbana, Ill., Cir. 682, June 1951, W. L. Burlison.

"Fruit Varieties for Indiana," Ext. Serv., Purdue Univ., Lafayette, Ind., Ext. Bul. 365, June 1951.

"Grassed Waterways and Terrace Outlets," Ext. Serv., Iowa State College, Ames, Iowa, Pamphlet 166, Apr. 1951, M. A. Anderson and D. O. Hull.

"Results of Research in 1950 by the Agricultural Experiment Station of the University of Kentucky," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., 63 A. R.

"Research in Agriculture," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., A. R. 1949-50.

"Origin and Growth of Agricultural Extension in Louisiana—1860-1948," Ext. Serv., La. State Univ., Baton Rouge, La., F. W. Williamson.

"Extension at Work in Lafourche," Ext. Serv., La. State Univ., Baton Rouge, La., Pub. 1054, Dec. 1950.

"Improvement of Native Dallis Grass in Louisiana," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Bul. No. 449, May 1951, C. R. Owen.

"Louisiana's Program for Peach Production," Ext. Pub. 1095, May 1951, B. L. Ferguson, R. S. Woodward, and L. Hawthorne; "Singletary Peas," Ext. Pub. 1097, June 1951, T. H. Milliken and G. A. Luno; Ext. Serv., La. State Univ., Baton Rouge, La.

"Extension Reviews Busy Year," Ext. Serv., Univ. of Me., Orono, Me., Bul. 416, Oct. 1951.

"Nebraska Outstate Varietal Tests of Spring Small Grains 1951," Agr. Exp. Sta., Univ. of Neb., Lincoln, Neb., Outstate Testing Cir. 16, Oct. 1951, A. F. Dreier and P. L. Ehlers.

"Soybean Production in Nebraska," Ext. Serv., Univ. of Neb., Lincoln, Neb., E.C. 192, W. E. Lyness and D. L. Gross.

"Growing and Storing Progress Potatoes," Ext. Serv., Univ. of Neb., Lincoln, Neb., Cir. 1272, March 1951, H. O. Werner.

"Biennial Report for the Two Years Ending June 30, 1950," Dept. of Agr., Concord, N. H.

"Ladino Clover, Its Mineral Requirements and Chemical Composition," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 759, Oct. 1951, I. Stewart and F. E. Bear.

"How to Grow Bush Fruits in the Home Garden," Ext. Serv., Ohio State Univ., Columbus, Ohio, Ext. Bul. 323, July 1951.

"Home Vegetable Garden," Cir. 196, E. L. Whitehead; "Woody Plant Material," Cir. 645, J. C. Garrett; Ext. Serv., Okla. A & M College, Stillwater, Okla.

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"Growing Blueberries in Oregon," Bul. 499, June 1951, C. A. Boller; "The Native Pacific Plum in Oregon," Bul. 502, Sept. 1951, A. N. Roberts and L. A. Hammers; Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg.

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"Cotton Variety Tests at Lubbock, 1947-50," P. R. 1381, July 6, 1951, L. L. Ray, J. Box, E. L. Thaxton, Jr., and D. L. Jones; "Greenwrap Tomato Variety Yield Tests in the Lower Rio Grande Valley, Spring 1951," P. R. 1387, July 10, 1951, P. W. Leeper; Agr. Exp. Sta., Texas A & M College, College Station, Texas.

"Recommended Utah Vegetable Varieties," Ext. Serv., Utah State College, Logan, Utah, Cir. 229, March 1951, E. M. Andersen.

"Farmers Handbook for the Columbia Basin Project," Ext. Serv., State College of Wash., Pullman, Wash.

Economics

"Some Economic Aspects of Beef Cattle Production in the Piedmont of Georgia," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Bul. 269, June 1951, O. Steanson.

"Estimated 1950 Salable Production of Tropical Flowers and Foliage, Territory of Hawaii," Ext. Serv., Univ. of Hawaii, Honolulu, Hawaii, Agr. Econ. Rpt. No. 6, May 1951, I. Rust.

"Production Requirements for Major Enterprises on Southern Idaho Irrigated Farms," Agr. Exp. Sta., Univ. of Ida., Mimeo. Leaflet No. 116, June 1951, R. C. Bevan.

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"Seasonal Variations of Indiana Farm Prices," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Bul. 566, Sept. 1951, D. Paarlberg.

"Trends in Legislation on Incorporation of Agricultural Cooperatives," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., S. C. 375, R. L. Kohls and J. R. Blais.

"The Economics of Crop Rotations and Land Use," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Res. Bul. 383, Aug. 1951, E. O. Heady and H. R. Jensen.

"Comparative Census of Maryland Agriculture, by Counties," Agr. Exp. Sta., Univ. of Md., College Park, Md., Misc. Pub. No. 113,

Aug. 1951, A. B. Hamilton.

"Marketing Mississippi Delta Cotton," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 484, Sept. 1951, C. M. Wells, Jr. and W. A. Faught.

"An Economic Analysis of the Tung Industry in Louisiana," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Mimeo. Cir. No. 119, Dec. 1950, J. A. McDaniel and F. E. Stanley.

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"Cost of Producing Filberts and Walnuts in Oregon," Agr. Exp. Sta., Ore. State College, Corvallis, Oreg., Cir. of Inf. 499, June 1951, G. W. Kuhlman.

"Texas Farm and Ranch Land Prices, 1950," Agr. Exp. Sta., Texas A & M College, College Station, Texas, P. R. 1389, Aug. 2, 1951, J. H. Southern and J. R. Motheral.

"Utah's Land Resources," Agr. Exp. Sta., Utah State College, Logan, Utah, Spec. Rpt. 4, June 1951, L. A. Reuss and G. T. Blanch.

"Keeping Up on the Farm Outlook," Ext. Cir. No. 199, Oct. 31, 1951; "Keeping Up on the Farm Outlook," Ext. Cir. No. 200, Nov. 30, 1951; Ext. Serv., State College of Wash., Pullman, Wash., K. Hobson.

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"Crops and Markets," Bur. of Agr. Econ., USDA, Washington, D. C., 1951 Edition, Vol. 28.

Simple Tests for Magnesium and Calcium . . .

(*From page* 14)

deficient castor beans grown by E. B. Earley also did not turn dot # 1 wine red. But most plants, even those slightly deficient in magnesium, turn dot # 1 red. Hybrid corn, Ohio 28B, has been found by L. L. Huber of the Pennsylvania State College to be sensitive to lower levels of magnesium, giving the typical magnesium deficiency symptoms for corn. In August 1951, on one of his plots where magnesium deficient symptoms were present in Hybrid Ohio 28B the tissue turned both dots # 1 and # 2 wine red but not # 3. On another soil area where this hybrid did not show the symptoms, its sap turned all three dots wine red.

While no definite correlations for any particular plant have been obtained so far, the results secured indicate that the test is probably sensitive within the deficiency range of magnesium concentration in plant sap.

As already mentioned, manganese and acid change the magnesium reagent to a reddish color. The buffer solution (# 3) is applied to prevent interference from the acidity of the plant sap. The manganese in plants grown on acid soils can sometimes be high enough to interfere. In such cases the test spot should be allowed to dry before a reading is taken. On drying, the red color due to manganese turns a grayed green, leaving an outer ring of wine-red color if magnesium is also present.

b. As a soil test.

The reagents required:

1. Reagent # 1 above (F241 solution).
2. A 23 per cent solution of sodium nitrate.

Preparation of the test papers: Squares 1½ × 1½ inches of Whatman # 1 filter paper are used for the soil test. In the middle of the square a large dot of the magnesium reagent (F241 solution) is made by applying it with a dropper pressed against the

paper and moved around to make a dot between ¾ and 1 inch in diameter. Air-dry and store in air-tight, dark container.

Running the test: A small pinch of soil (15-20 mgm.) of fine air-dried soil is placed in the center of the large dot, in a small cone-shaped mound. Add one drop of the 23 per cent sodium nitrate solution onto the soil cone in such a way that the solution will penetrate the soil mass and flow through the soil and then spread out into the paper. This extracts the exchangeable magnesium from the soil and carries it into the surrounding area.

Interpretation of the test: The typical wine-red color appears on the paper, its intensity and size depending on the amount of exchangeable magnesium in the soil—the more the magnesium the wider the ring of wine-red color surrounding the soil cone. For very acid soil, the exchangeable hydrogen also changes F241 to a pinkish color, differing from wine red, which can be eliminated by buffer solution.

A series of soils of known exchangeable magnesium content can be tested and used as standards for estimating the amount in unknown samples. Amounts less than 100 pounds per acre (50 ppm.) of exchangeable magnesium did not turn the spot wine red, 250 pounds per acre gave a wine-red band, 350 gave a wider band, and 850 pounds per acre gave a still wider band.

Suitable for Field Tests

Once correlations are established between exchangeable magnesium and crop needs, it is probable that this test can be used as a rapid means of separating deficient soils from sufficient soils.

The soils on the Pennsylvania State College plots mentioned above gave no wine-red color where the corn showed magnesium deficiency symptoms but did give a narrow band of wine-red color with the soil which did not cause symptoms on the corn. The soils low in exchangeable magnesium found in southern Illinois give a slight color and do not cause deficiency symptoms on corn.

The above tests add two new elements to the list of tissue tests which can be made in the field without any more equipment than can be carried in one's pockets. The only difficulty is that the calcium papers must be made fresh every few days. The dipicrylamine test as described by Melsted of the University of Illinois (6) is already in use and has proved to be an effective, easy-to-use test for plant tissues, being a simplification of the test as used by A. C. Richer of Pennsylvania State College (8) and G. N. Hoffer of the American Potash Institute. The tests for phosphorus and nitrate originally described by Bray (1) (2) had also been applied to tissue testing by Hoffer using filter paper techniques similar to those described above.

The three tissue tests for potassium, phosphorus, and nitrate nitrogen have been combined into a simple vestpocket tissue test kit which makes the tests for all three nutrients on a single strip of prepared filter paper. This kit is made by J. N. Bray, Box 51, Urbana, Illinois.

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Ladino Clover

(*From page 22*)

minishes after each cutting. Such a condition is approached on overgrazed pastures. In alfalfa and red clover, starch is stored in the roots and crowns of the plants, but in ladino it is stored mainly in the stolons. When a ladino plant reaches maturity, the stored starches are at a maximum. When the plant is harvested, the starch reserves are depleted by the new growth until new leaves are formed. In due time the amount of starch manufactured by photosynthesis exceeds that used in growth processes.

TABLE V.—ACRE YIELDS OF LADINO AND ORCHARD GRASS GROWN SEPARATELY AND IN COMBINATION

Dry-weight basis

Treatment		Crop†	Acre Yield				
No.	Kind*		July 8	Aug. 8	Aug. 29	Oct. 17	Total
			lb.	*lb.*	*lb.*	*lb.*	*lb.*
1	K	L	444	863	835	945	3087
2	K	O	501	934	497	831	2763
3	K	L	192	281	440	508	1421
3	K	O	451	782	423	686	2342
3	K	T	643	1063	863	1194	3763
4	NK	L	554	743	1094	1222	3613
5	NK	O	973	1140	1286	1137	4536
6	NK	L	178	192	192	149	711
6	NK	O	743	1119	1176	988	4026
6	NK	T	921	1311	1368	1137	4737
7	2K	L	444	881	895	1226	3446
8	2K	O	515	870	455	732	2572
9	2K	L	195	224	352	455	1226
9	2K	O	433	810	419	778	2440
9	2K	T	628	1034	771	1233	3666
10	N2K	L	650	767	975	1140	3532
11	N2K	O	913	1183	1243	1055	4394
12	N2K	L	220	238	320	313	1091
12	N2K	O	700	1066	966	1062	3794
12	N2K	T	920	1304	1286	1375	4885
13	3K	L	547	888	938	1261	3634
14	3K	O	528	858	517	661	2564
15	3K	L	181	277	253	259	970
15	3K	O	398	757	405	664	2224
15	3K	T	579	1034	658	923	3194
16	N3K	L	600	824	941	1343	3708
17	N3K	O	1034	1293	1304	1144	4775
18	N3K	L	227	235	270	249	981
18	N3K	O	671	1130	1027	1087	3915
18	N3K	T	898	1365	1297	1336	4896

* K = 60 pounds K_2O; N = 120 pounds N.
† L = ladino; O = orchard grass; T = total ladino and orchard grass for mixed plots 3, 6, 9, 12, 15, and 18.

Fig. 3. In mixtures of ladino and orchard grass, absence of nitrogen in the topdressing favored growth of the ladino. Treatment 3, 200 pounds P_2O_5 and 60 pounds K_2O an acre. Photograph, taken prior to third cutting, shows 50 per cent ladino, on dry-weight basis.

A field experiment was conducted to test the effects of fertilizers on the rates of depletion and renewal of starch in ladino stolons following harvesting. N and K_2O in the forms of NH_4NO_3 and KCl were applied separately and jointly to a 3-year-old stand of ladino at the rate of 200 pounds each an acre. The ladino was harvested June 10, 1950, and all the K and 100 pounds N were applied at that time. The clover was harvested again on August 10 and the remaining N was applied. Commencing August 9, the day before the second cutting, 100 stolons were obtained from each plot every other afternoon at sunset.

The percentage K, Ca, Mg, Na, P, and Cl remained fairly constant following harvesting. K was highest in stolons from plots fertilized with K and lowest from plots fertilized with N. The Cl content of stolons from plots fertilized with K was almost

TABLE VI.—PERCENTAGE LADINO IN LADINO-ORCHARD-GRASS PLOTS AT VARIOUS DATES

Dry-weight basis

Treatment		Percentage Ladino			
No.	Kind*	July 8	Aug. 8	Aug. 29	Oct. 17
3	K	29.9	26.4	51.0	42.5
9	2K	31.0	21.7	45.7	36.9
15	3K	31.3	26.8	38.4	28.1
6	NK	19.3	14.6	14.0	13.1
12	N2K	23.9	18.3	24.9	22.8
18	N3K	25.3	17.2	20.8	18.6

* K = 60 pounds K_2O; N = 120 pounds N an acre.

Fig. 4. Application of nitrogen stimulated the grass in mixed stands of ladino and orchard grass. Treatment 6, 120 pounds N an acre added to treatment 3. Photograph, taken on same date as that of Figure 3 and showing same number plants. The mixture on this plot contained 18 per cent ladino and 82 per cent orchard grass, on dry-weight basis.

twice as great as that from plots receiving N plus K. The N content of the stolons was increased as much as 25 per cent by applications of N. The percentage N in the stolons decreased following harvesting, and reached a minimum 14 to 18 days later.

Reducing sugar, total sugar, and invert sugar percentages remained fairly constant following harvesting. The starch content showed a decline for 3 to 5 days (Fig. 5). Replenishment of starch reserves commenced 11 days after harvesting, and the original level was reached in about 17 days. Starch was lowest in stolons from plots that

TABLE VII.—NITROGEN AND MINERAL CONTENT OF FIRST-CUTTING LADINO AND ORCHARD GRASS

Dry-weight basis

Treatment		Crop†	K	Ca	Mg	Na	N	P	S	Fe	Mn
No.	Kind*		%	%	%	%	%	%	%	*ppm.*	*ppm.*
7	2K	L	3.5	1.3	0.47	0.14	3.70	0.31	0.21	310	76
8	2K	O	4.5	0.3	0.32	0.02	3.20	0.41	0.27	170	186
9	2K	L	2.9	1.3	0.44	0.14	3.44	0.28	0.10	470	56
9	2K	O	4.5	0.3	0.34	0.02	3.21	0.44	0.18	160	160
10	N2K	L	3.1	1.3	0.48	0.10	3.75	0.28	0.16	300	90
11	N2K	O	4.5	0.4	0.30	0.10	3.08	0.43	0.26	195	150
12	N2K	L	3.1	1.4	0.48	0.10	3.32	0.28	0.07	440	50
12	N2K	O	4.9	0.3	0.32	0.02	3.60	0.46	0.19	178	140

* K = 60 pounds K_2O; N = 120 pounds N an acre.
† L = ladino; O = orchard grass; with treatments 9 and 12 a mixture of ladino and orchard grass was grown.

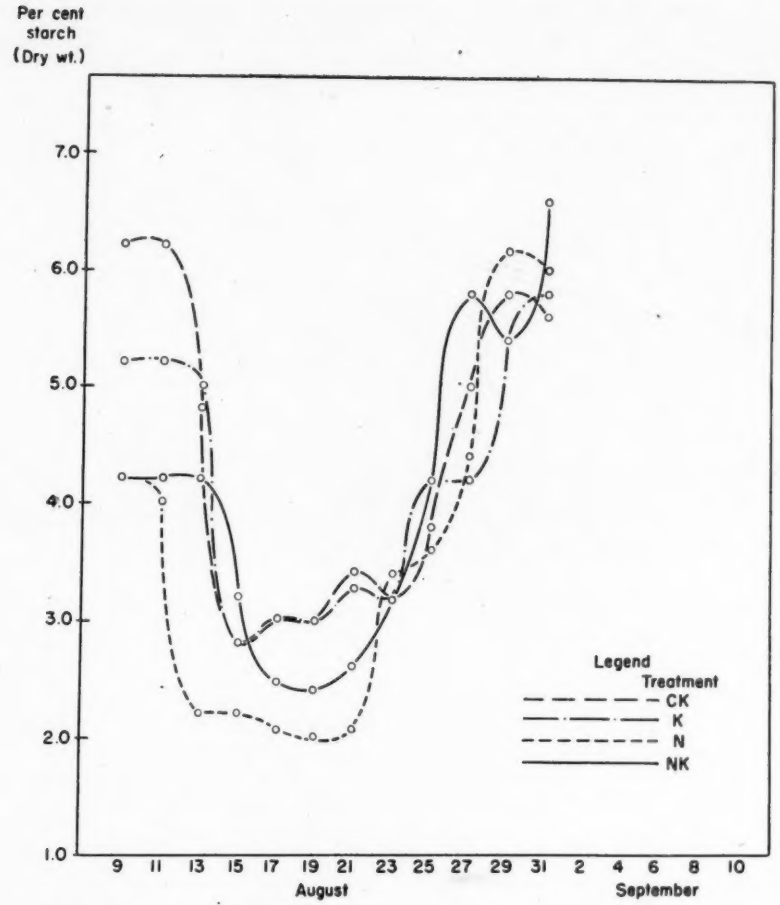

Fig. 5. Starch content of ladino stolons. Ladino harvested on August 9 and 10, 1950; stolon samples collected on days indicated. CK = no treatment. K and N applied separately and together at rate of 200 pounds an acre each.

had received N. The total available carbohydrates (sugar, starch, and hemicellulose) followed a curve similar to that of starch.

Radioautographs Revealed Nutrient Distribution in Ladino

Radioactive Ca45[2] was fed to ladino grown in sand culture in the greenhouse. Three microcuries were added to the solution 2 weeks prior to harvesting. After harvesting, the plants were pressed and then placed in contact with X-ray film for 1 month. Figure 6 is the resulting radioautograph. The lighter areas indicate that the Ca45 was concentrated in the veins of the leaves. It was almost entirely absent from the pulvinus,* the tissue connecting the ladino leaflets to the petioles. Analyses revealed an accumulation of K, Na, and Cl in this region. Near-absence of Ca may explain the ease with which legume leaves shatter

[2] The Ca45 used in this investigation was supplied by the Oak Ridge Laboratories on authorization from the Isotopes Division, U. S. Atomic Energy Commission.

* These observations are based on the findings of David Ririe and S. J. Toth, reported in "Plant Studies with Radiocalcium" in the January 1952 issue of Soil Science.

TABLE VIII.—NITROGEN AND MINERAL ELEMENTS REMOVED FROM THE SOIL BY LADINO AND ORCHARD GRASS

Acre basis

Treatment		Crop†	K	Ca	Mg	N	P
No.	Kind*						
			lb.	*lb.*	*lb.*	*lb.*	*lb.*
1	K	L	87	45	12	113	8
2	K	O	104	9	9	64	10
3	K	L	39	22	6	48	4
3	K	O	90	6	9	57	8
3	K	T	129	28	15	105	12
4	NK	L	101	53	15	130	10
5	NK	O	175	14	17	122	13
6	NK	L	19	9	4	23	2
6	NK	O	148	13	14	117	14
6	NK	T	167	22	18	140	16
7	2K	L	106	47	14	120	9
8	2K	O	100	9	9	59	10
9	2K	L	34	18	5	43	4
9	2K	O	195	6	7	67	10
9	2K	T	229	24	12	110	14
10	N2K	L	107	45	14	127	10
11	N2K	O	185	16	15	124	16
12	N2K	L	32	14	4	35	4
12	N2K	O	159	12	12	107	16
12	N2K	T	191	26	16	142	20
13	3K	L	118	48	13	127	10
14	3K	O	105	8	9	60	9
15	3K	L	28	13	4	33	4
15	3K	O	88	7	6	53	9
15	3K	T	116	20	10	86	13
16	N3K	L	115	48	13	131	10
17	N3K	O	202	13	16	134	17
18	N3K	L	29	14	4	33	3
18	N3K	O	165	11	16	112	13
18	N3K	T	194	25	20	145	16

* K = 60 pounds K_2O; N = 120 pounds N an acre.
† L = ladino clover; O = orchard grass; T = total for mixed ladino and orchard grass plots 3, 6, 9, 12, 15, and 18.

when hay is being harvested, since Ca functions partly in holding plant cells together.

Because of the short half-life of radioactive K, it was impossible to obtain an autograph showing the distribution of this element in ladino, and therefore radioactive Na22[3] was used instead (Fig. 7). The plant had been grown in a nutrient solution containing a high concentration of K. The Na22, which was supplied later, tended to accumulate in the outer edges of the older leaves. When a ladino plant was grown in a K-deficient solution, the isotope accumulated in the growing point and in the young leaves. Although Na is not known to be essential for ladino, it has properties similar to those of K

[3] The Na22 used was obtained from M. A. Tuve, Director, Department of Terrestrial Magnetism, Carnegie Institution of Washington, D. C.

TABLE IX.—NITROGEN AND MINERAL CONTENT OF LADINO AND ORCHARD GRASS FROM VARIOUS STATES

Dry-weight basis

Location	K	Ca	Mg	Na	N	P	Mn
	%	%	%	%	%	%	*ppm.*
Ladino							
Storrs, Conn.	1.8	1.7	0.30	0.21	4.08	0.29	56
Ithaca, N. Y.	1.9	1.6	0.40	0.17	3.80	0.29	60
Athens Co., Ohio	2.1	1.5	0.35	0.04	3.74	0.32	130
Lexington, Ky.	2.2	1.8	0.30	0.04	3.84	0.37	74
Abell Co., W. Va.	2.8	0.8	0.27	0.01	3.69	0.32	80
Washington, Pa.	2.0	1.8	0.30	0.06	3.82	0.26	46
New Brunswick, N. J.	2.9	1.3	0.44	0.14	3.44	0.28	56
Orchard grass							
Storrs, Conn.	3.3	0.4	0.21	0.05	2.65	0.44	164
Ithaca, N. Y.	2.6	0.8	0.31	0.07	3.28	0.31	44
Athens Co., Ohio	2.6	0.5	0.19	0.01	2.74	0.32	90
Lexington, Ky.	3.0	0.5	0.33	0.02	3.06	0.34	174
Abell Co., W. Va.	2.8	0.4	0.19	0.01	2.77	0.31	56
Washington, Pa.	3.0	0.7	0.19	0.01	2.81	0.39	70
New Brunswick, N. J.	4.5	0.3	0.34	0.02	3.21	0.44	160

and is known to stimulate the growth of many plants when the amount of K available to the plant is low.

Another radioautograph (Fig. 8) was made of a ladino stolon by the use of radioactive Cl36[4]. The isotope accumulated in the leaf petioles and midribs. Although Cl is not known to be needed by ladino, it often constitutes more than 1 per cent of the dry matter. When supplied to ladino as muriate of potash, Cl tended to substitute for N, S, and P in the ladino and to lower its protein content. Conversely, the Cl content of ladino stolons was reduced one half by applications of N to the soil. (*To be continued*)

(Figures mentioned and not appearing in this section will be found in the next installment in the February issue.)

[4] The Cl36 used in this investigation was supplied by the Oak Ridge Laboratories on authorization from the Isotopes Division, U. S. Atomic Energy Commission.

"SOIL is made up of three main components, the solid particles and the liquids and gases in the pores. Each of these parts is essential for plant growth. The condition of the water and the air in the soil depends on the size, the composition, and the arrangement of the solid particles, but also on the climatic conditions and the activities of man. It is the task of the soil physicist to study and organize these facts and to recommend the type of management that will result in the greatest sustained crop growth." . . . *Dr. Helmut Kohnke, Department of Agronomy, Purdue University.*

Magnesium Soils of Hawaii

(*From page* 26)

is an abnormal magnesium to potassium ratio. In order to correct this condition it is necessary to apply potash at a very heavy rate—an initial application of 1,000 pounds of potash per acre followed by annual applications of approximately 200 pounds per acre. The potash application must be continued until the plant tissue will have at least 1½ per cent potassium. This figure is approximate; the exact figure will be determined by the nature of the crop. The important thing to remember in these soils is that the initial potash application must be high.

The "magnesium soils" of the Hawaiian Islands are very productive with proper management. The system of management of these soils in Hawaii should be applicable to many other tropical black soils.

Peanut Production

(*From page* 12)

nuts annually in North Carolina. In some counties there may be as much as 20-30% reduction in yields due to the attacks of certain insects. The insects attacking peanuts may be divided into two major groups: (1) insects feeding on foliage, (2) insects feeding on the roots and fruit.

Two of the most commonly observed pests which attack foliage are thrips and leaf hoppers. Thrips attack young, developing leaflets, causing scars and misshapen leaves. Damage is most severe in early spring especially during cool, damp weather. With severe infestation the plant may be markedly stunted, providing a condition which is commonly referred to by farmers as the "pouts."

The leaf hopper sucks plant juices from the leaves causing them to turn yellow at the tips. With severe infestation the yellowing may spread to the entire leaf. Thrips and leaf hoppers may be controlled by the use of 5% DDT dust at the rate of 15 pounds per acre.

In some areas considerable damage to peanuts results from attacks by the Southern corn rootworm, the larvae of the twelve-spotted cucumber beetle. This grub bores into the developing pod causing the fruit to decay and often shed from the vines. Although the damage is usually more severe on soils moderately high in organic matter, significant yield increases have been obtained by controlling this insect in experiments on well-drained, light-colored soils. Several insecticides have been found to offer good control for this pest. However, some of these materials such as benzene hexachloride and lindane have been found to impart objectionable off-flavors to the fruit. Further research on the insect pests of peanuts is still in progress.

Intensive research programs are providing the answers to many questions regarding the supposedly mysterious peanut crop. With the proper application of this information, peanut yields should be markedly increased. For example, yields of 4,800 pounds per acre—four times the State average—have been obtained in experiments in North Carolina through the use of a combination of improved practices. With performances such as this the lowly "goober" should soon rid itself of the stigma of peculiarity and further assert itself as the King of the Oil Crops.

[3] Information on insects supplied by W. M. Kulash, Bulletin 70, N. C. Dept. of Public Instruction, Pages 32-38, 1951.

Breaking Old Sod

(*From page* 5)

potash from cement mills and blast furnaces to check possible means to recover part of it. Extracting potash from wool scourings and treatment of alunite for potash output were in the agenda for 1917. A bureau laboratory was just starting at Arlington Farms, Virginia, to test the fixing of atmospheric nitrogen, but it was hampered by wartime scarcities in the line of machinery. Apparatus had been set up to experiment with the Ostwald process of oxidizing ammonia for making nitric acid. They were also studying processes for rendering garbage to secure some valuable nitrogenous substances from city wastes. A Cottrell precipitator was working at the bureau laboratory to make phosphoric acid from rock phosphates. All this activity came at a time when more farmers were being weaned away from old superstitions and prejudices against use of anything but stable manure to enhance acre yields—a revolution in practices which came to its best fulfillment in the second world war rather than in the first one.

Alongside this rise of national interest in fertilizers, there were many experiments with alfalfa and lespedeza, and the notable tests on green manuring—which later became the famous "go-down" soil-conserving practices of the 1940-45 period.

Now we can trace some of the moves of our farm leaders as taken from the handy files of USDA's weekly news letter for the spring of 1917.

On March 17 Secretary Houston tried to overcome hysteria which had developed over the food situation. He stated: "There is nothing in the food situation of our country which justifies hysterical thinking or acting. This is no time for hysteria, nor is this a time for the thoughts of the American people to be directed or dominated by those who have the interests of another country primarily at heart.

"The price of food is high. A full and satisfactory explanation of prevailing prices is not possible on the basis of existing knowledge. It is only recently that agencies have been created here to study food distribution, and we have not all the necessary facts as yet to enable us to arrive at the truth. Where the food supply is, who owns it, what may be the difficulties of securing it, whether the local market shortages are due to car shortages, whether there is artificial manipulation and control, no one can state with certainty. The facts must be had as a prerequisite for the working out of a fair and just and economical system of marketing.

"Hence the investigation into foods directed by the President ought to be made promptly, and Congress should give the Federal Trade Commission and the Department of Agriculture the necessary funds to do it. Such an investigation cannot give immediate relief, but it would be absurd to oppose it for this reason. It is probable that as a result of it large permanent improvements may be made."

Swinging into conservation, the Secretary said: "We should consider earnestly the matter of food conservation and the elimination of waste. As a nation we seem to have disdain of economizing. In many homes there is a strong feeling that it is only decent to provide more food than will be eaten and that it is demeaning to reckon closely. However, dietary experts of the Department tell me that we have an annual food waste of about $700 million."

With this keynote of conservation and preservation uppermost, the state agricultural forces and the Department began a public crusade by means of posters and all kinds of printed emphasis, with some of the following

headlines and subheads:

"Help feed yourself—make home gardens and back yards productive, demonstrate thrift in your homes. . . . Waste no food, don't feed high-priced human food to hogs and chickens and don't send valuable food to incinerators and fertilizer heaps.

"Abandon food prejudices, don't be finicky, cook foods properly and give simple foods a fair trial. . . . Watch your kitchen wastes, don't throw away any left-overs that can be reheated or combined with other foods to make palatable and nourishing meals.

"Let nothing spoil, keep perishable foods cold, keep food clean and covered, guard against vermin, can or preserve your surplus."

BUT were conservation and waste elimination enough—even with a trial of the unpopular forces that would limit courses and quantities of food for the public consumption? Secretary Houston observed that only recently England had started to deal directly with food production along with the recognition that farmers should be guaranteed a minimum price over a period of years. This was brand new philosophy. So here is what the Secretary commented as to the farmer's position in a national drive for greater food reserves:

"Obviously, if farmers are to be induced to increase acreage, a guaranty of a reasonable price by the nation or the community seems necessary. Farmers are governed by the same thinking and motives as the rest of the people. They are patriotic; but it is unlikely that they will undertake greatly to increase their output unless they are reasonably sure that it will be profitable for them to do so. One could no more expect a farmer to increase his product greatly without a knowledge of the outcome than he could expect a manufacturer to double the production of shoes unless he knew he could dispose of them profitably. Those who are urging farmers to increase their acreage beyond that which their own judgment dictates know very little about the psychology of farmers, or of other people for that matter, or about the fundamental necessities of the situation. Farmers are going to do their own thinking in the matter and will not follow anybody's dictation."

He reviewed the somewhat disappointing crop yields of 1916, with considerable black stem-rust of wheat and late blight of potatoes. He said that livestock numbers had increased and much livestock increase was evident in the South, where a campaign in behalf of a sounder agriculture had been under way.

"The Department and other agricultural agencies are giving careful attention to current problems," it was declared. "The solution will certainly not involve a Federal dictatorship, and it is also unlikely that it will involve a dictatorship in any state or community. In any event the difficulties would be nearly insuperable. We have a continent to deal with, and there are difficulties of double jurisdiction. For instance, in fixing a minimum price for food, the Federal government could deal only with commodities passing into interstate commerce. The states might be hampered by any attempts to fix prices. Intelligent planning in conjunction with the operation of normal forces are what we need, and these only can bring about a satisfactory result."

ON April 18, 1917, the Department came out flatly with a call for sweeping increase in the acreage of staple cereals and livestock products, including the oil-seed crops that hitherto had received but scant attention. Then during the last week of April a national farm conference on the absorbing defense topic of food was held in St. Louis for the states east of the Rocky Mountains, and at the University of California, Berkeley, for the mountain and far west states. Secretary Houston presided at the one, and Benjamin Ide

NO_3 Ca
P NH_4
K *The Spurway* NO_2
pH *Method gives* CO_3
Fe *you much more* SO_2
Mg *—for less—* Cl
Na Mn
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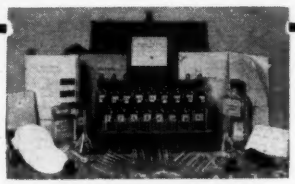

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Wheeler, Head of California University, was in the chair at the other. There were 32 states represented at the former and 8 states at the latter. After informal discussions, the body decided to name committees as customary, and to deal with the subject in four divisions—labor and production, prices and distribution, economy and utilization, and effective organization.

The agricultural colleges were represented on the resolutions committee by W. O. Thompson, Ohio; H. J. Waters, Kansas; H. L. Russell, Wisconsin; Eugene Davenport, Illinois; Clarence Ousley, Texas; and J. M. Hamilton, Montana. Kenyon L. Butterfield of Michigan, Jewell Mayes of Missouri, and Charles S. Wilson of New York were also in the thick of things.

Mobilization was just as big and useful a word then as it is now in crop-boosting efforts. To get things going fast the meeting at St. Louis urged a set-up something like this: A relatively small central agricultural body whose services and presence might be required in Washington constantly, composed of a group of men with wide acquaintance and executive ability; a large national advisory body of the leading agricultural agencies and associations related to both production and distribution; a small central agricultural body in each state to be designated by the governor and coordinated with the state council of defense; and lastly, such urban, county, and other local bodies for agriculture as the state authorities and the defense councils might see fit to suggest. The session recommended an appropriation of $25 million or "such part of it as may be needed immediately by the Secretary of Agriculture."

History has a habit of repeating in many ways, especially in the fundamental ones. Just notice how familiar the following grave pronouncements of this meeting in St. Louis sound today when we are "fresh up against" similar objectives with like obstacles: "The

plan for public defense should include a definite provision that enlistment for the food supply is just as important as for service at the front. Besides more than half of those applying for war service and rejected for physical reasons, there are more than two million boys between 15 and 19 years in cities and towns who are not now engaged in productive work vital to the national emergency. These are the most important hitherto unorganized and unutilized farm labor force available in this emergency."

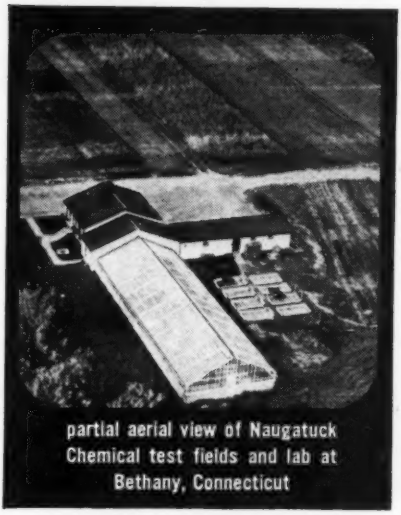
Government agencies, they said, should do all in their power to bring about an adequate supply of freight cars for moving food and farm supplies. They wanted the market information services of the states and the USDA to be extended and made more effective.

They asked for preference in the movement of shipments of farm machinery, seeds, fertilizers, and spraying materials to enable the farmers to meet the task assigned to them.

The meetings called for power in the hands of the Secretary to establish market grades and classes of farm products, and to issue licenses to warehouses, packing plants, produce exchanges, storage places, brokers, auctioneers, commission merchants, and all other agencies engaged in marketing and distributing farm products.

The Pacific Coast meeting added a special request that the county agents and other Federal field men be given such official designation as to disassociate them from ordinary civilians and give them dignity and authority such as other Federal officers who are prosecuting the war.

Queer and strange-sounding as some of those decisions are to active leaders of the present, after all they laid the foundation for what we have since been able to do in mass production in times of peril. Our hope is that the 1952 campaign will begin and end in plenty and in peace.



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Circulars

Tomatoes (General)
Asparagus (General)
Vine Crops (General)
Sweet Potatoes (General)
Better Corn (Midwest)
The Cow and Her Pasture (General)

Reprints

F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What Is the Matter with Your Soil?
J-2-43 Maintaining Fertility When Growing Peanuts
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
A-1-44 What's in That Fertilizer Bag?
QQ-12-44 Leaf Analysis—A Guide to Better Crops
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—The Aristocrat
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
ZZ-11-45 First Things First in Soil Fertility
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
I-2-47 Fertilizers and Human Health
T-4-47 Fertilizer Practices for Profitable Tobacco
AA-5-47 The Potassium Content of Farm Crops
TT-11-47 How Different Plant Nutrients Influence Plant Growth
VV-11-47 Are You Pasture Conscious?
R-4-48—Needs of the Corn Crop
X-6-48 Applying Fertilizers in Solution
AA-6-48 The Chemical Composition of Agricultural Potash Salts
GG-10-48 Starved Plants Show Their Hunger
OO-11-48 The Use of Soil Sampling Tubes
TT-12-48 Season-long Pasture for New England
F-2-49 Fertilizing Tomatoes for Earliness and Quality
CC-8-49 Efficient Vegetable Production Calls for Soil Improvement
KK-10-49 An Approved Soybean Program for North Carolina
QQ-11-49 Some Fundamentals of Soil Building
RR-11-49 Alfalfa as a Money Crop in the South
SS-12-49 Fertilizing Vegetable Crops
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K-3-50 Metering Dry Fertilizers and Soil Amendments into Irrigation Systems
L-3-50 Food for Thought About Food
O-4-50 Birdsfoot Trefoil—A Promising Forage Crop
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V-5-50 Potassium Cures Cherry Curl Leaf
X-5-50 Fertilizers Help Make Humus
Z-6-50 Potash Tissue Test for Peach Leaves
AA-8-50 Alfalfa—Its Mineral Requirements and Chemical Composition
BB-8-50 Trends in Soil Management of Peach Orchards
HH-11-50 The Minor Element Problem
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Request bookings from your nearest distributor

It was at a church meeting in a small town and a man got up and said:

"Now, folks, we've got to do something for the preacher. We don't want to put the whole burden on any one family, but upon all of us, turn and turn about. Now, what can we do for the preacher?"

"Well," said one old lady, "I kin eat him, but I can't sleep him."

"That's fine," said the leader. "Now, who's next?"

"Well," said another, "if Sister Jenkins is going to eat him, I'll agree to sleep him, but I can't wash him."

"That's fine," was the reply. "Who's next?"

Finally another woman spoke up. "I'll wash him," she said slowly, "but I ain't much good on boiled shirts!"

* * *

"Final peace may come rather quickly, or it may come slowly," recently reported a news correspondent. It is this sort of rash and unguarded statement that endangers the nation.

* * *

A sailor was hailed into court for fighting.

"Your honor," he told the judge, "I was in a telephone booth talking to my girl and a guy wants to use the phone. So he opens the door, grabs me by the neck and tosses me out of the booth."

"Then you got angry?" asked the judge.

"Well, a little," replied the sailor, "but I didn't get really mad until he grabbed my girl and threw her out, too."

A disgusted parent wrote a note of complaint to the teacher, and wound it up with: "If all Herbert learns in school is to swear, I'll keep him home and teach him myself!"

* * *

"Adultery is as bad as a murder. Isn't that so, Sister Smith?" shouted the evangelist. "I don't know," replied Sister Smith. "I never killed anybody."

* * *

Mr. Fafoofnick stormed into a side-street clothing store. "You made for me a suit," he screamed, "the slivvs of which are being vun mile too long!"

"Well," said the manager, "maybe they are a trifle long."

"Trifle!" moaned Fafoofnick. "I'm talling you dey are a mile too long de slivvs!"

"All right," said the manager. "So they are a mile too long. How much shall we shorten them?"

Fafoofnick reflected carefully. "You should take off," he said, "about an eight uff an eench."

* * *

The first sign of a little boy's growing up comes when he refuses to be seen in the ladies' rest room. . . .

* * *

They were huddled closer together than houses in Boston. The lights were low—very low. He pressed his lips into her mouselike ear and whispered. "What are you thinking about, darling?"

"The same thing you are, my own," she shyly answered.

"I'll race you to the ice box!"

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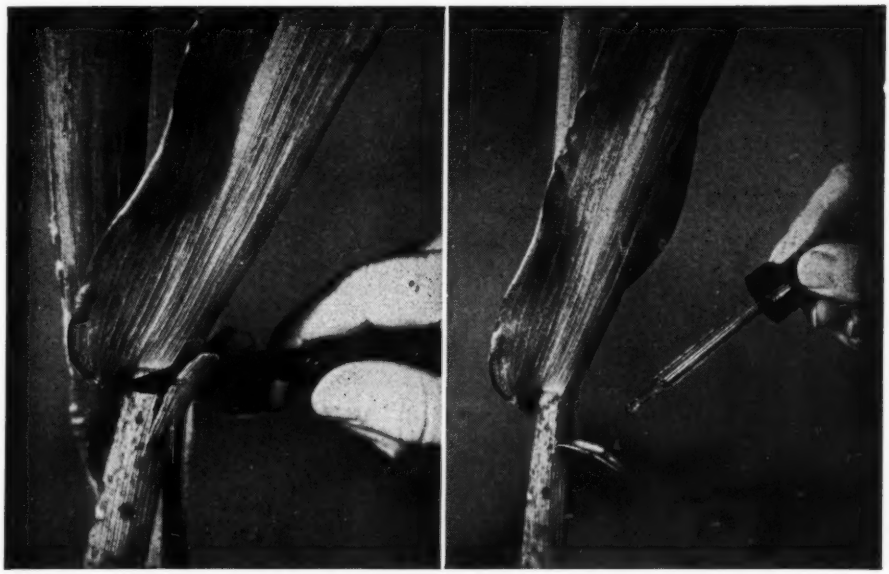
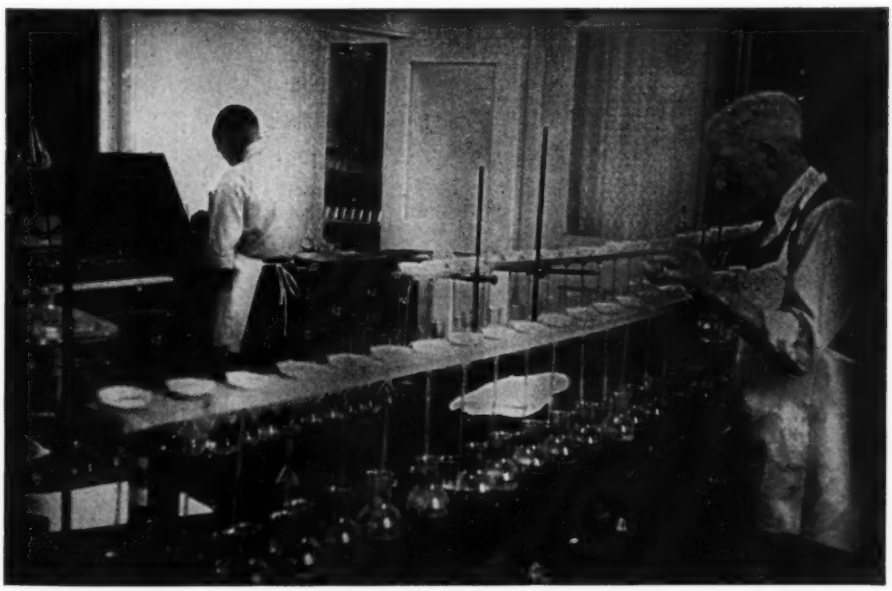


Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.



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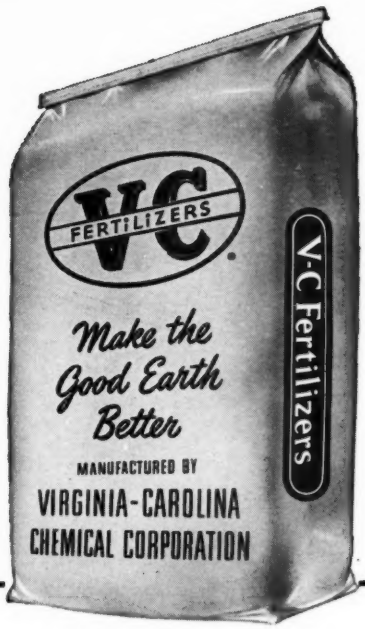

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